Transmittal

Haley and Ward, Inc.

Civil and Environmental Engineers
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To:	Malcolm Harper	From:	Greg Eldridge, Myles Killar
Company:	MassDEP CERO	Date:	June 12, 2013
Re:	Medway Water Conservation Grant, 10-05/WCG, Project Report		
Job #:	MDY-107	CC:	Dave D'Amico
Via:	*Mail:* X	*Overnight:*	*Courier:*

For your information		Approved	
For your review	X	Approved as noted	
For your signature		Returned to you for correction	

- Message:

Enclosed you will find the Final Project Report for Medway. If you have any questions or concerns please feel free to contact me.

MEDWAY WATER CONSERVATION GRANT PROJECT

PROJECT NUMBER 10-05/WCG

YEARS PROJECT CONDUCTED
2011-2013

PREPARED BY:
MEDWAY DEPARTMENT OF PUBLIC SERVICES, WATER AND SEWER DIVISION
AND HALEY AND WARD, INC.

PREPARED FOR:
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF RESOURCE PROTECTION

AND

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 1

MEDWAY WATER CONSERVATION GRANT PROJECT

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EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS
Richard K. Sullivan, Jr., Secretary

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Kenneth L. Kimmell, Commissioner

BUREAU OF RESOURCE PROTECTION
Beth Card, Assistant Commissioner

DIVISION OF MUNICIPAL SERVICES
Steven J. McCurdy, Director

This project has been financed partially with federal funds from the U.S. Environmental Protection Agency (USEPA) to the Massachusetts Department of Environmental Protection (MassDEP) under a Water Conservation Competitive Grant. The contents do not necessarily reflect the views and policies of EPA nor of MassDEP, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

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Project Summary

The Medway Department of Public Services, Water and Sewer Division goals for the Water Conservation Grant were to promote water conservation, locate and repair leaks, identify and reduce unaccounted for water loss and water demand from the drinking water works and distribution system, especially during the summer months. The source of water supply is located within the Town of Medway; sufficient water supply is a current challenge. The project included replacing residential water meters, completing a comprehensive leak detection survey and conducting consequent leak repairs, and implementing an Outreach and Education program. Additionally, quarterly progress reports were completed. The funding source (grant monies versus Medway's match or monies) are described in the 'Successes' section of the report. The tasks along with their deliverables, as outlined in the project scope, are defined below:

Task 1: Leak Detection Survey

Conduct a leak detection survey of the water mains and appurtenances of the water distribution system network. This task will consist of a comprehensive leak detection survey of 74 miles of main, hydrants, gate valves, and service connections. As part of the leak detection survey, use data loggers and a correlator to detect, record, analyze, and pinpoint the sound created by underground water leakage. Upon the identification of a leak, estimate the flow rate. After leaks are repaired, re-survey the repair sites to confirm that no other leaks remain. The survey was completed by Liston Utility Services.

Task 2: Leak Repair

Establish a priority system to implement leak repairs. Repairs will be performed in conformance with the Department's water management act permit and with industry standards and will be documented with leak reports including estimates of leakage rates based on visual observation once infrastructure is exposed. This task is part of the Department's match.

Task 3: Public Outreach Program

Encourage water conservation through the implementation of a robust public outreach and

education program and conservation policies. A water conservationist will conduct training on water conservation and outreach methods, which will be attended by Department of Public Services' administrators, Medway Water & Sewer Commissioners, and Water & Sewer Division operators and staff. An educational booth will be planned and staffed at the annual Medway Pride Day celebration by Water and Sewer Division personnel. This effort will include teaching practical steps about water conservation and distributing educational and conservation materials.

Task 4: Meter Replacement Program

Purchase and install up to fifty (50) new service meters, which will replace meters over ten (10) years old. Describe the selection process for choosing which meters to replace. Document the make, model, size, and number of particular meters replaced. Summarize the requisite savings from accurate billing statements as the result of replaced meters. This task is part of the Department’s match.

Successes

The first and second tasks of the Water Conservation Grant required the Medway Department of Public Services, Water and Sewer Division to conduct a leak detection survey and follow-up with repairs. An experienced leak detection surveyor conducted a comprehensive leak detection survey of the entire distribution system, seventy-four (74) miles of water mains, with continuing support from the Department. Leak detection leads to reduced water loss, financial gains, increased system knowledge, and reduced disruption to customers, and is therefore essential to any conservation program. An overview of the pertinent system information the survey methodology and results can be found in the Leak Detection Survey Report, Attachment B. The report addresses the requirements for the leak detection survey and leak repair. The leak detection survey was funded through grant money supplied by MassDEP.

Attachment A is the Leak Detection Survey Summary. Four leaks were service leaks; the other was a leaking hydrant. After the leaks were identified, their leakage was estimated. The combined estimated loss from the leaks was 36 gallons per minute (gpm). Following the repairs, the water savings was estimated at 51,840 gallons per day, or 18,921,600 gallons per year. Applying Medway's cost to pump and treat water (storage, distribution, system operation and maintenance costs) of $0.00127/gallon, the annual water savings was approximately $23,900 which would have been lost revenue not to mention a wasted resource. This is a significant savings for any Department and illustrates the effectiveness of leak detection and more generally a water conservation program. Saving 18.9 million gallons each year is a significant amount of water not only for public water professionals, but for the public as well.

Following the identification of the leaks, Medway promptly sent out a crew for repair. Leaks were repaired and the leak detection surveyor returned to the site and confirmed there was no longer any leakage. For more in depth information on any of the aforementioned subjects, please refer to the Leak Detection Survey Report, Attachment B.

The table below summarizes the water and monetary savings attributed to water conservation grant

work, specifically leak detection and repair:

Task	Water Savings	
	(gal/year)	($/year)*
Leak Detection & Repair	18,921,600	$ 23,900

*The water savings in dollar amount were arrived at by applying Medway's cost to produce and deliver water (as described above) of $0.00127 per gallon to the leakage found in the leak detection survey.

The third successful task of the Water Conservation Grant was for Medway to conduct service meter replacement. Meter error data was obtained from a recently water audit, see Appendix C. Meter calibration was not part of the meter replacement work. The replacement work was funded by the Medway Department of Public Services, Water and Sewer Division as a financial match to the conservation grant.

During the grant period, Medway replaced one hundred thirty-two (132) 5/8" residential service meters. All newly installed meters were the Department's standard: Sensus Metering Systems. Service meters were replaced by age, oldest meters being the priority. Exceptions were when the meter failed (stopped) completely and was no longer registering flow.

Accurate billing savings was calculated by applying the median residential water rate of $6.31 per 100 cubic feet to the unmetered flow associated with the 132 replaced meters. Based on a water audit previously conducted in Medway, 5/8" residential service meters under registered an average of 9.7%, see Appendix C. There are a total of 3,307 residential meters, therefore with 132 replaced, approximately 4.0% of the meters were replaced. The total volume delivered 260 million gallons per year (MGY) based on the Annual Statistical Report (ASR), therefore 10.4 MGY, or 1,345 '100 cubic feet' were delivered through the 132 replaced meters. Applying the median water rate of $6.31 per 100 ft^3 (or 746.3 gal), approximately $8,490 was saved due to accurate billing.

A second calculation methodology confirms the quantity of water and monetary savings. Assuming a household size of four (4) and applying Medway's ASR residential gallons per capita day of 63 (gallons/person/day), the 132 replaced service meters failed to meter approximately 12.1 million gallons annually. Extending this to a dollar amount, assuming the median water rate

employed by Medway of $6.31 per 100 ft^3 (or 746.3 gal), the savings from accurate billing statements is over $10,160.

The fourth task was to implement and enhance Medway's Water Conservation Outreach and Education Program. This collaboration was funded partially by grant monies from MassDEP and partially by the Town of Medway as a financial match. A conservationist conducted training on water conservation outreach methods, and also planned to assist in outreach at the Department of Public Services' educational booth at the annual Medway Pride Day celebration.

There were a total of fourteen attendees at the Outreach and Education training session including the Director and the Deputy Director of the Department of Public Services, a Water and Sewer (W&S) Commissioner, the W&S Superintendent and Assistant Superintendent, W&S operators and staff. The water conservationist spoke about how to reach out to existing local organizations and combine forces on water conservation education. It was explained how water conservation is a community effort wherein the water department, schools, and community organizations like the local garden club all play a vital role. Following the water conservation outreach training, the Department of Public Services' staff ran an educational water conservation booth of the Town's annual festival, Medway Pride Day. Educational materials were distributed to the public. The grant monies funded educational materials, several hours of consultant assistance in the form of outreach implementation, while the Town funded all personnel hours.

In the initial work scope, an elementary school visit was planned. Medway eliminated the school visit and in its place the Department of Public Services erected and manned an educational booth at the Town's annual Medway Pride Day Festival. The festival is an existing annual event and the thought was that better results could be obtained and resources used more effectively by integrating outreach efforts into this established festival.

Difficulties

Potential problems were minimal with this grant. Each task incorporated planning, management, and collaboration built into the performed work. Maintaining clear and effective communication between all involved parties proved difficult at times, but did not result in setbacks.

Lessons Learned

One year was an appropriate amount of time to conduct a comprehensive leak detection survey, follow up leak repairs, perform meter replacement, and implement a public outreach and education program.

Potential problems were minimal with this grant because each task incorporated planning and management built into the performed work. The leak detection survey was planned between the water superintendent and the leak detection surveyor. The Public Outreach and Education was conducted with participation between the Department of Public Services, the Medway Water & Sewer Commissioners, civil engineering management consultant Haley and Ward, Inc, and a water conservationist.

To further improve the meter replacement program, a few recommendations can be made. Meter testing and calibration would be a very helpful component to add to the program, but it must be stressed that standards, such as AWWA's, are modeled and followed strictly as discussed above. These industry standards have been refined over decades and will certainly improve any water utilities program and yield water savings. Additionally, service meter testing would be best conducted regularly throughout the year rather than being batched in large groups over large spans of time. With frequent testing, the training the operators receive will better be reinforced and retained. Finally, when each meter is tested the customer's water use history should be recorded along with the meter error. The Department will be able to track how water use impacts meter error, and looking forward, incorporate this knowledge into their meter replacement program.

Recommendations

There are several recommendations for each task, which if implemented, will improve recording of flows for sources of supply and distribution system measurement systems.

Annual leak detection surveys are recommended to identify and subsequently repair leaks. The Department is encouraged to implement a routine hydrant maintenance and inspection program to check hydrants for unauthorized use and complete shutdown.

Speaking generally about water loss and unaccounted for water, unmetered authorized uses and miscellaneous losses will always be difficult categories to quantify. Estimable sources of unmetered use such as fire fighting, bleeders, water main flushing, storage tank overflows, sewer system maintenance, street cleaning and construction can best be accounted for by working with the appropriate utility or department in developing and implementing quantification methodology. This can be achieved by working with management and stressing the importance of tight water use records. Still harder to quantify are unmetered miscellaneous losses such as bleeders, unauthorized connections and theft. A good strategy for keeping records in these instances would be first identifying each event that occurs, isolating it and estimating the water use as an individual occurrence.

It is recommended that the successful elements of the Public Outreach and Education program be replicated annually such as the Medway Pride Day festival booth with education handouts. Maintaining relations and communication with local organizations is a great way to perpetuate Medway's outreach program. Additionally, materials such as flyers and mailers could be distributed throughout the community.

Attachment A: 2011 Leak Detection Survey Summary and Reporting Forms

DATE OF DETECTION	DATE OF REPAIR	LOCATION	ESTIMATED LEAKAGE GPM	ESTIMATED LEAKAGE GPD	ESTIMATED LEAKAGE GPY
12/5/2011	12/12/12	10 Fisher St (Service Leak)	4	5,760	2,102,400
12/9/2011	12/17/12	7 Evergreen St (Service Leak)	10	14,440	5,256,000
12/9/2011	12/17/12	43 Lovering St (Service Leak)	10	14,400	5,256,000
12/12/2011	12/19/12	60 Winthrop St (Service Leak)	11	15,840	5,781,600
12/8/2011	12/17/12	15 Delmar Rd (Hydrant Leak)	1	1,440	525,600

Total estimated loss = 36 GPM (gallons per minute) = 51,840 GPD (gallons per day) = 18,921,600 GPY (gallons per year)

Total annual volume of drinking water produced = 362,427,000 GPY

Estimated loss as a percentage of total annual volume = 5.2%

Attachment B: 2011 Water Distribution System Leak Detection Survey Methodology and Report

**RADCOM SoundSens* user guide available from manufacturer; direct web link not available.

Town of Medway Leak Detection Survey

Operator:

James D. Liston
30 Years of Experience
Please see Resume PDF attachment.

Equipment:

I use SoundSens correlating datalogger system manufactured by Radcom Technologies LTD.
Please see attached Data Sheet
Equipment is always operated per SOP. I helped in development of these procedures
The equipment is maintained per schedule set forth by Radcom.
Radcom recommends the batteries in the logger be replaced every 5 years. I replace every 2 years.
The equipment does not require calibration. But a Calibration check is performed every week.
See SoundSens User guide PDF attachment.

Survey:

1. The SoundSens deployment decisions are made based upon the configuration of the distribution system being surveyed. The loggers are placed on contact points necessary to perform an accurate survey. The logger spacing is determined by the distance between hydrants and or valves in the distribution system being surveyed. At intersections where a hydrant does not exist, a main line valve is utilized as a contact, with only one valve needed per intersection. Liston Utility Services try's to maintain a maximum distance between sensors to 400 feet. This is done because 2 sensors must detect the indication of leakage in order to correlate and pinpoint the location of the leak. Leak sound travels at greater distances in metal pipes such as cast and ductile iron pipes. Asbestos Cement pipes are not as good but close to iron pipes in terms of leak noise traveling. Plastic pipes should have the sensors placed no more than 200 feet apart to accurately detect and pinpoint the presence of leakage.
    - If hydrants are spaced 300 feet apart SoundSens will be deployed every 300 feet.
    - Additional sensors will be placed at intersections for more contacts(not required)
    - To correlate you need at least 2 sensors to hear that same leak
2. Standard Operation Procedure to perform a SoundSens Leak correlation Survey
    - Have a distribution map of the system to be surveyed
    - On site the SoundSens Correlating dataloggers are programmed a delay time to deploy the loggers and then perform 2 separate leak survey correlations. The correlations are spaced between 5 minutes and 10 minutes apart. Each logger has a specific identity number programmed into it.
    - The distribution map is marked where each logger has been deployed
    - In the correlating software a diagram is completed where the loggers are connected as they are placed in the field.
    - The information is then saved as a file listing the streets that have been surveyed.
    - The loggers are retrieved when both programmed correlations have been finished.
    - The loggers are then downloaded into SoundSens leak correlation software.
    - The software then automatically correlates every set of loggers that are connected.
    - If the correlation shows an indication of leakage, the actual pipe information is imputed to accurately pinpoint the location of the leak. (Pipe size, material, and distance between 2 loggers)
    - Additional correlations may be performed to check leak location is deemed necessary.
    - If a leak is found from the correlation, the street is marked where the leak is.
    - The town is then notified of the leak.
3. The survey is time and date stamped; the leak correlated is also time and date stamped.
4. Weather and traffic conditions do not affect the logger/correlating system.
5. SoundSens are loggers that store leak noise data and uses that data to correlate for the leak underground water leakage.

6. SoundSens loggers are a correlator as well.
7. SoundSens correlator will be used to pinpoint the sound created by underground water leakage
8. SoundSens correlator will be used to survey the entire water distribution system.
9. Ground Material of leak site will be documented as well as weather conditions
10. Pipe Material should be documented on Distribution Map provided by town.
11. Service pipe material may not be known by the town
12. Miles of main surveyed will be documented in Final Report.
13. See Proposal PDF attachment.

Reporting

1. Each leak identified will be documented
2. A diagram will be provided for each leak located
3. Each leak failure will be documented along with specific ground cover material.
4. Leakage will be estimated
5. Each leak will be classified based upon estimate
6. Classification provided in proposal; see attached proposal.
7. Survey data will be totalized in simple chart
8. Miles of main surveyed will be documented
9. Weather Condition along with temperature will be reported on Leak Report Sheet. See attached leak report sheet

Follow-up

Surveyor will most likely not present during repair but not sure. It will depend when the town does the repair.
Estimated leakage should be verified by drop in master meter consumption.
If when leak is repaired a picture can be taken by town at time of repair to better estimate leakage if needed.
Date Time/ Weather Conditions during repair - Town will need to provide this data
Each area will be retested after leak repair.

Final Report

The Town of Medway Massachusetts

2011
Correlation
Leak Detection Survey

Liston Utiltiy Services
19 Mauriello Drive
Stoneham, MA 02180-2775
Phone: 781 635 7711
Fax: 781 435 1480
WWW.LISTONUTILITYSERVICES.COM

January 1, 2012

Final Report
Correlation Water Leak Detection Survey
Town of Medway, MA
Department of Public Works
155 Village Street
Medway, MA 02053

The Town of Medway, Massachusetts contracted the services of Liston Utility Services to perform a correlation leak detection survey on their water distribution system.

Beginning November 28, 2011 and continuing through December 15, 2011 Liston Utility Services conducted the comprehensive correlation leak detection survey on the water distribution system of the Town of Medway MA as outlined in the Scope of work dated August 30, 2011. This survey was performed on 74 miles of distribution system to reduce unaccounted for water by identifying hidden and surfaced leaks.

The leak correlation survey consists of magnetically connecting leak correlating dataloggers to every intersection of the water distribution system to be surveyed. This is accomplished by attaching SoundSens Loggers to hydrants, hydrant valves, mainline valves and or service connections. The loggers are programmed to turn on at pre-determined intervals and collect leak noise data. Once the data has been stored in the loggers they are then retrieved and placed into a docking station for downloading into the leak correlation software for analyzing. Once the data from the loggers collected are downloaded into the software a diagram is completed that connects adjacent loggers. The data is then analyzed for potential leakage. When a leak had been identified additional correlations may be performed to pinpoint the exact location of the leak. Once completely satisfied with the location, the water department is notified and the leak is turned into the water department for repair.

The survey was performed entirely by James D. Liston utilizing Radcom Technologies correlating system SoundSens.

During the survey a total of 5 leaks were located, they consisted of 4 service leaks, and 1 hydrant. A leak report sheet as well as the correlation data is included in this report.

Leaks Located:

Type	Location	Estimated Leakage (GPD)
Service	10 Fisher Street	4 GPM
Service	7 Evergreen Street	10 GPM
Service	43 Lovering Street	10 GPM
Service	60 Winthrop Street	11 GPM
Hydrant	@ 15 Delmar Road	1 GPM
Total Estimated Leakage		36 GPM

18,921,600 Gallons per Year (18.92 million gallons of water)

Conclusion:

I found the water distribution system to be in excellent condition.

Unaccounted for water is a very complex issue with many variables involved, with undetected leaks being one of those variables. A water department requires timely and accurate data from their master meters feeding the distribution system to help determine if and when a leak survey needs to be performed. The survey should not be performed solely on the absence of time since the last survey. It should be based upon accurate flow data into the distribution system. The data that should be look at is total consumption, minimum night rates. If the consumption starts to rise, then at a certain threshold a new leak survey should be performed.

If a SCADA system is unavailable to monitor master meters then a battery powered telemetry datalogging system should be utilized at all the master metered sites as well as storage tank to monitor levels. I recommend RADCOM Technologies Multilog Data logger for the solution. This logger is a standard 4-channel unit and can be equipped with a telephone line modem or a cellular interface. The unit is completely battery powered water proof with a guarantee battery life of 5 years. The logger downloads into a very powerful multi licensed software package as well as alarms out for high, low and minimum nightline data points. The logger can read a 4-20 mA input as well as power its own internal or external pressure and flow sensors.

Recommendations:

- Continue leak detection survey to maintain system.
- That all compound and turbine water meter accounts be investigated for potential unaccounted for water. That these accounts be data logged and then sized properly based upon the data results. You may also want to look at all 2 inch displacement meters as well..

I would like to thank the Town of Medway for the opportunity to serve you and look forward to doing your leak detection surveys in the future. If you have any questions on the report and or would like to speak further on my recommendations please call me at 781 635 7711. I can also reach by emailing me at jim@listonutilityservcies.com.

Our goal is to serve clients to the best of our ability. Thank you for choosing to do business with us.

Sincerely,

James D. Liston
Liston Utility Service
www.listonutilityservices.com
jim@listonutilityservices.com

Liston Utility Services
19 Mauriello Drive Stoneham, MA 02180-2775
781-635-7711
781-435-1480 Fax
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Medway Leak Correlation Survey Tests

Survey Test 1- Date November 28, 2011
Juniper Road., Curtis Landing, Hunter Lane, Causeway Street., Puddingstone, Hickory Drive, Broken Street.

Survey Test 2 – Date November 28, 2011
Sun Valley Drive, Ellis Street, Saddle Hill Road, Spruce Road, Bridle Path Way, Cardinal Lane, Hill View Terrace, Golden Rod Drive

Survey Test 3 – Date November 29, 2011
Village Street, Lewis Drive, Lakeshore Drive, Chandlewood Drive, Island Road, Popomatic Street, Walker Street, Pearl Street, Oakland Street

Survey Test 4 – Date November 29, 2011
Gable Way, Dean Street, Crestview Avenue, Queen Way, Villa Drive, Kelley Street, Orchard Circle, Henry Avenue, Malloy Avenue

Survey Test 5- Date November 30, 2011
Oakview Circle, Oakland Street, Vernon Road, Chestnut Street, New City Road, Crooks Street, North Street

Survey Test 6 – Date November 30, 2011
Fuller Brook Lane, School Street, Broad Street, North Street, Holliston Street, Village Street, Stanford Street, River Street, Anderson Street Ave

Survey Test 7 – Date December 1, 2011
Dogwood Lane, Azalea Drive, Pheasant Run Road, Quail Drive, Hookset Circle, Bayberry Lane, Summer Street, School

Survey Test 8 – Date December 1, 2011
Highland Street, Oak Street, Fales Street, Knollwood Road, 2 New Delevopments – Milford Street.

Survey Test 9 – Date December 2, 2011
Laurelwood Lane, Milford Street, Clark Road, Liberty Drive, Short Street, Jasmine Road, Trotter Drive, Alder Street, Lost Hill Drive, Blue Robbin Lane

Survey Test 10 – Date December 5, 2011
West Street, Granite Street, Old Summer Street, Main Street, Ardmore Circle, Daffodil Lane, Millbrook Road

Survey Test 11 – Date December 5, 2011
Milford Street, Gray Squirrel Drive, Fisher Street, Little Tree Road, Rustic Road, Village Street, Country Lane

2 Hydrant Service Leak at 9 Fisher Street

Survey Test 12 – Date December 6, 2011
Waterview Drive, Village Street, Sherwood Drive, Franklin Street, Stagecoach Way, Norfolk Avenue, Lincoln Street, Mann Street, Wellington Street, High Street

Survey Test 13 – Date December 7, 2011
Industrial Park Road, Douglas Street, Coffee Street, Holliston Street, Robin Circle Karen Avenue, Carol Lane, Meryl Street, Gorwin Drive

Survey Test 14 – Date December 8, 2011
Lovering Street, Sunset Drive, Florence Circle, Grace Terrace, Meadow Road, Pond Street

Possible Leak on Lovering Street. Located Service Leak to 43 Lovering Street

Survey Test 15 – Date December 8, 2011
Evergreen Street, Mahan Circle, Maple Lane, Grove Street, Temple Street, Dellar Road, Maple Street, Priscilla Road, Adam Street, Winthrop Street, Clover Lane

Leak 7 Evergreen Street, possible leak on Winthrop Street
Hydrant Leak 15 Delmar Road

Survey Test 16 – Date December 9 2011
Winthrop Street, Ohlson Circle

Service Leak @ 60 Winthrop Street

Survey Test 17 – Date December 12, 2011
Winthrop Street, Hill Street, Cider Mill Road, Homestead Drive, Fairway Lane, Holliston Street, Woodland Pond, Ellis Street, Walnut Lane

Survey Test 18 – Date December 12, 2011
Village Street, Richardson Street, William Street, Forest Road, Phillips Street, Guernsey Street, Wellington Street, Samoset Circle, Shaw Street, Kadin Centre Street, Chares River Road Area

Survey Test 19 – Date December 14, 2011
Howe Street PVC

Survey Test 20 – December 14, 2011
Howe Street, Lovering Street, Ohlson Circle, New Street

Survey Test 21 – December 14, 2011
Holliston Street, Main Street, Winthrop Street, Kennart Road, Kenny Drive, Koyview Place

Survey Test 22 – December 14, 2011
Skyline Drive, Fairway Lane, Hickory Drive

Survey Test 23 – December 15, 2011
Fox Run Road, Stoney Ridge Pond, Hawthorne Road, Castle Road

Survey Test 24 – December 15, 2011
Hollbrook Street

Survey Test 25 – December 15, 2011
Daniels Road, Brandy Wind Road

Survey Test 26 – December 15, 2011
Village Street, Legion Avenue, Prospect Street, Cole Avenue, Cassidy Lane

Survey Test 27 – December 15, 2011
Campbell Street, Charles Street, Haven Street, Village Street

Liston Utility Services

19 Mauriello Drive, Stoneham, MA 02801-2775

Phone 781 635 7711 **Fax 781 435 1480**

Page No. 1

Date December 5, 2011

Ownership Public Private Easement

Leak Indication classification

I C II B (III A)

Leakage Control Report

Water Report

Weather

Company **Town of Medway** Address **155 Village Street**

City **Medway** State **Massachusetts** **02053**

Address 10 Fisher Street

N

Indication of Leak

Sonic		X
Surfaced Water		
Correlation		X

Leak Detected at:

Main Valve	X
Curb Valve	
Meter Box	
Selected Test	
Hydrant	X

Leak appears to be on

Main	
Service	X
Joint Connection	
Hydrant	
Valve	
Misc	

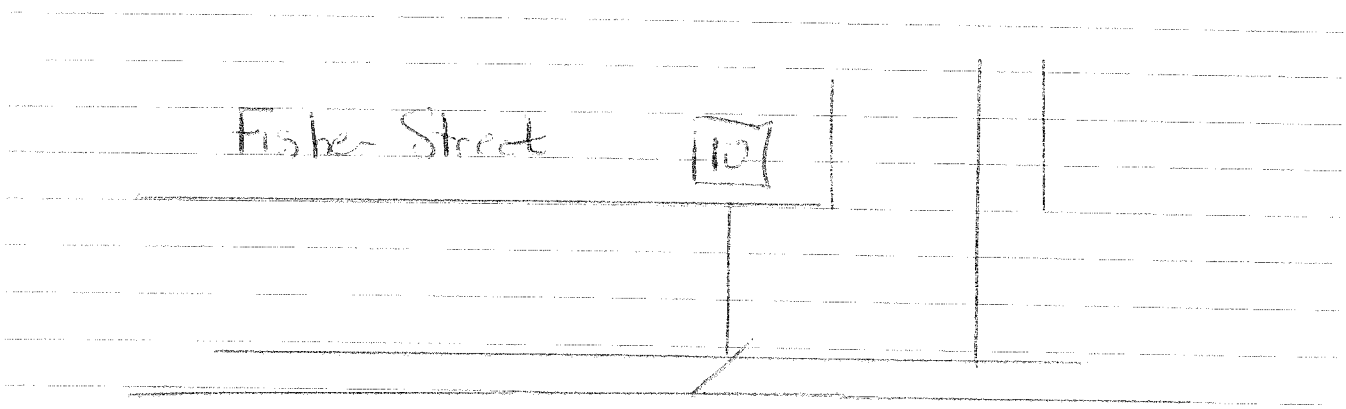
Cover

Concrete	
Asphalt	X
Brick	
Gravel	
Soil	
Other	

Estimated Leakage

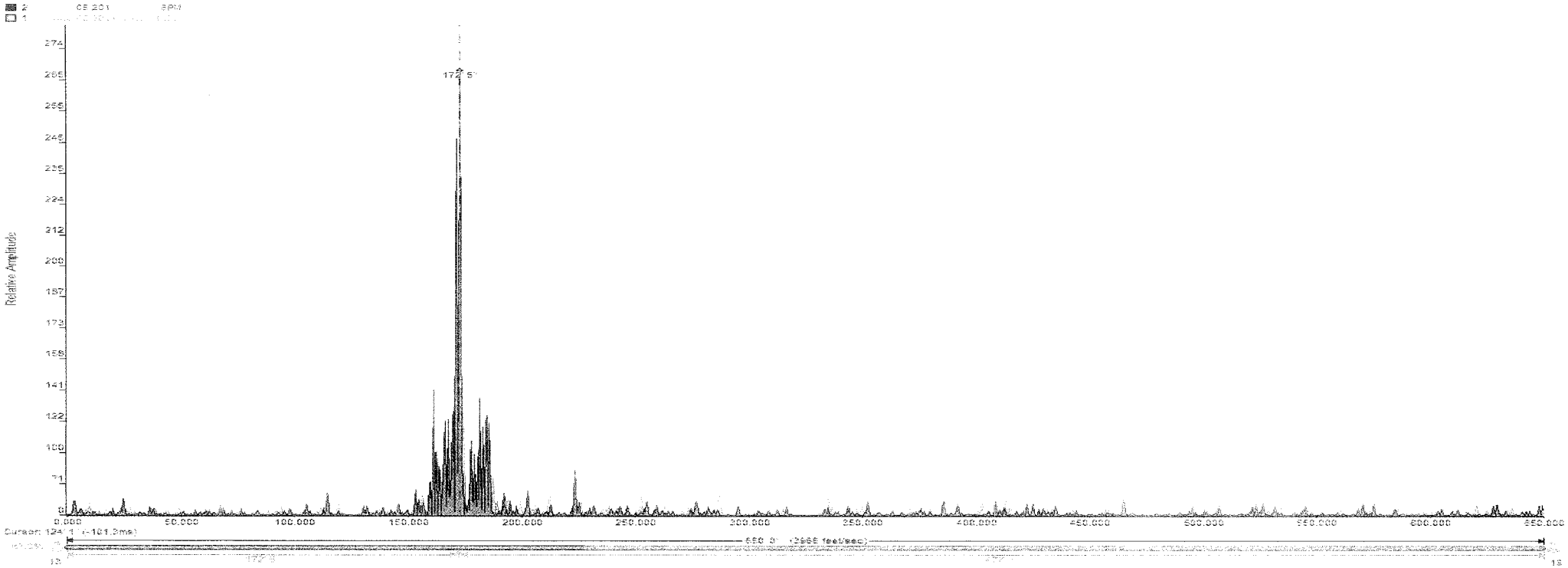
4 GPM

Leak Pipe Material



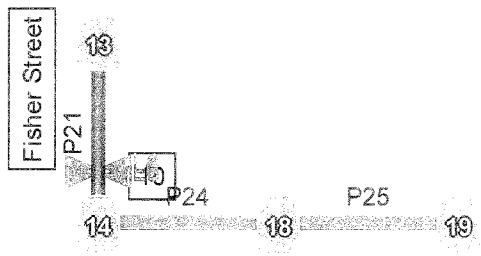
Remarks Leak was multi correlated and found to be on the service to 10 Fisher Street

Long Side



Pipe ID	Length	Diameter	Material	Sound Velocity
P21	229' 0"	12"	Cast Iron	3770 feet/sec
P24	331' 0"	8"	Ductile Iron	4072 feet/sec
P25	90' 0"	8"	Ductile Iron	4072 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	171' 8" from 13	13 -> 18	79.9%	Dec 05 2011, 01:00:16PM
L2	169' 3" from 13	13 -> 18	82.1%	Dec 05 2011, 12:55:16PM
L3	161' 4" from 13	13 -> 14	78.8%	Dec 05 2011, 01:00:16PM
L4	159' 4" from 13	13 -> 14	80.2%	Dec 05 2011, 12:55:16PM
L5	172' 10" from 13	13 -> 19	82.1%	Dec 05 2011, 01:00:16PM
L6	172' 5" from 13	13 -> 19	87.3%	Dec 05 2011, 12:55:16PM



Liston Utility Services

19 Mauriello Drive, Stoneham, MA 02801-2775

Phone 781 635 7711 **Fax 781 435 1480**

Page No. 2

Date December 9, 2011

Ownership Public (Private) Easement

Leak Indication classification

(I C) II B III A

Leakage Control Report
Water Report

Weather

Company **Town of Medway** Address **155 Village Street**

City **Medway** State **Massachusetts** **02053**

Address 7 Evergreen Street

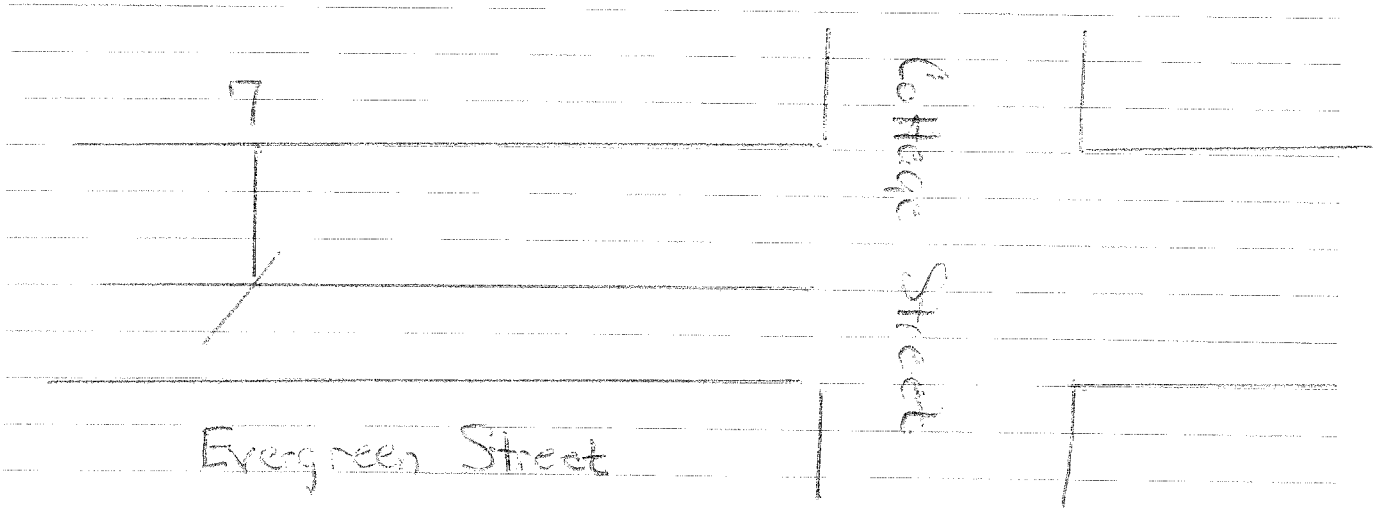
N

Indication of Leak		Leak Detected at:		Leak appears to be on		Cover	
Sonic		Main Valve	X	Main		Concrete	
Surfaced Water		Curb Valve	X	Service	X	Asphalt	X
Correlation	X	Meter Box		Joint Connection		Brick	
		Selected Test		Hydrant		Gravel	
		Hydrant	X	Valve		Soil	
				Misc		Other	

Estimated Leakage

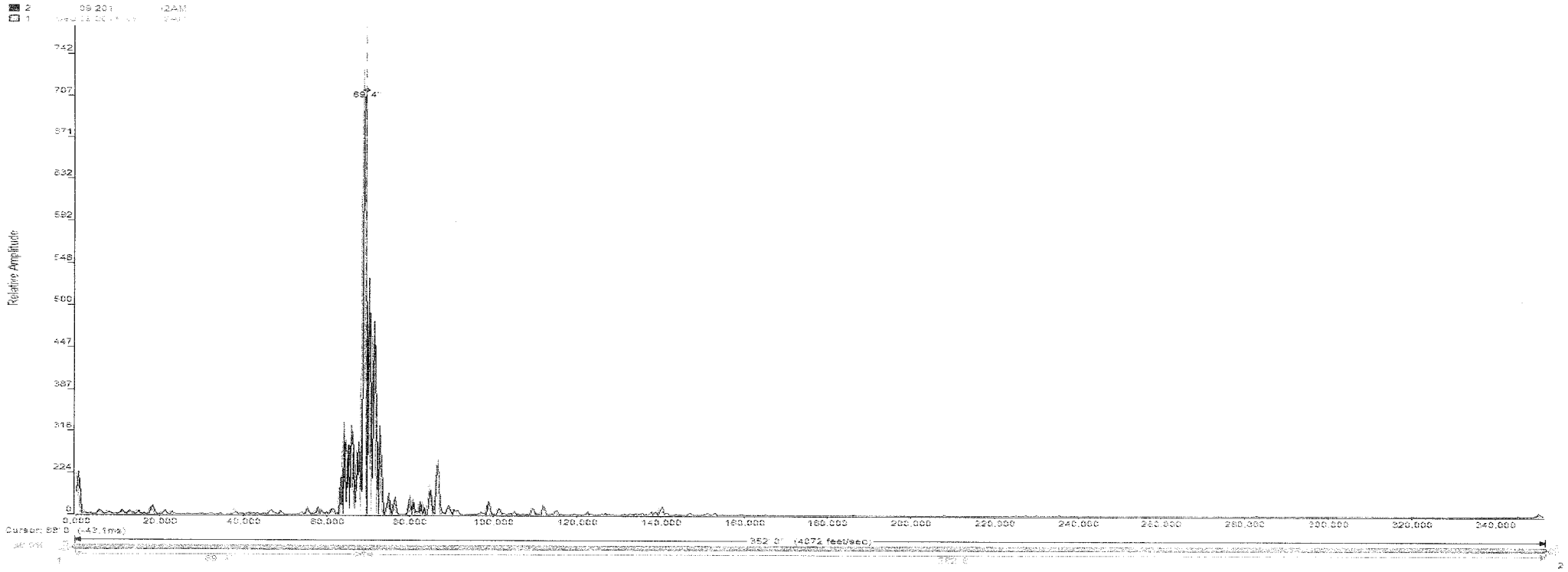
10 GPM

Leak Pipe Material



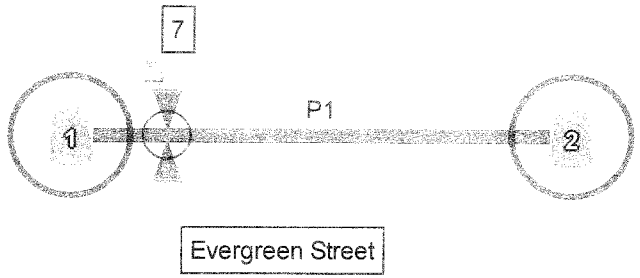
Remarks

Leak was correlated and found to be on the service to 7 Evergreen STREET Long side



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	352' 0"	8"	Ductile Iron	4072 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	68' 10" from 1	1 -> 2	88.7%	Dec 09 2011, 09:23:12AM
L2	69' 4" from 1	1 -> 2	88.0%	Dec 09 2011, 09:33:12AM
L3	69' 4" from 1	1 -> 2	88.0%	Dec 09 2011, 09:33:12AM



Liston Utility Services

19 Mauriello Drive, Stoneham, MA 02801-2775

Phone 781 635 7711 **Fax 781 435 1480**

Page No. 3

Date December 9, 2011

Ownership Public Private Easement

Leak Indication classification

(I C) II B III A

Leakage Control Report

Water Report

Weather

Company **Town of Medway** Address **155 Village Street**

City **Medway** State **Massachusetts** **02053**

Address 43 Levering Street

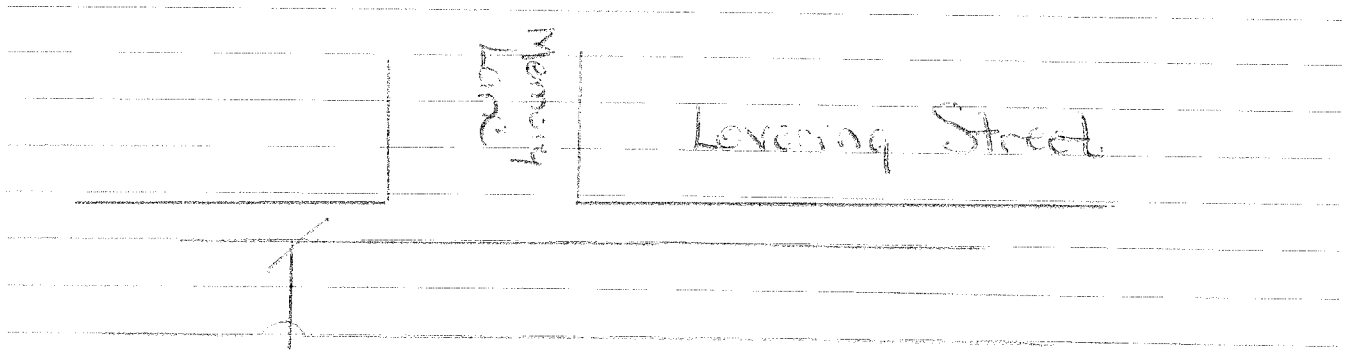
N

Indication of Leak		Leak Detected at:		Leak appears to be on		Cover	
Sonic	X	Main Valve	X	Main		Concrete	
Surfaced Water		Curb Valve		Service	X	Asphalt	X
Correlation	X	Meter Box		Joint Connection		Brick	
		Selected Test		Hydrant		Gravel	
		Hydrant	X	Valve		Soil	
				Misc		Other	

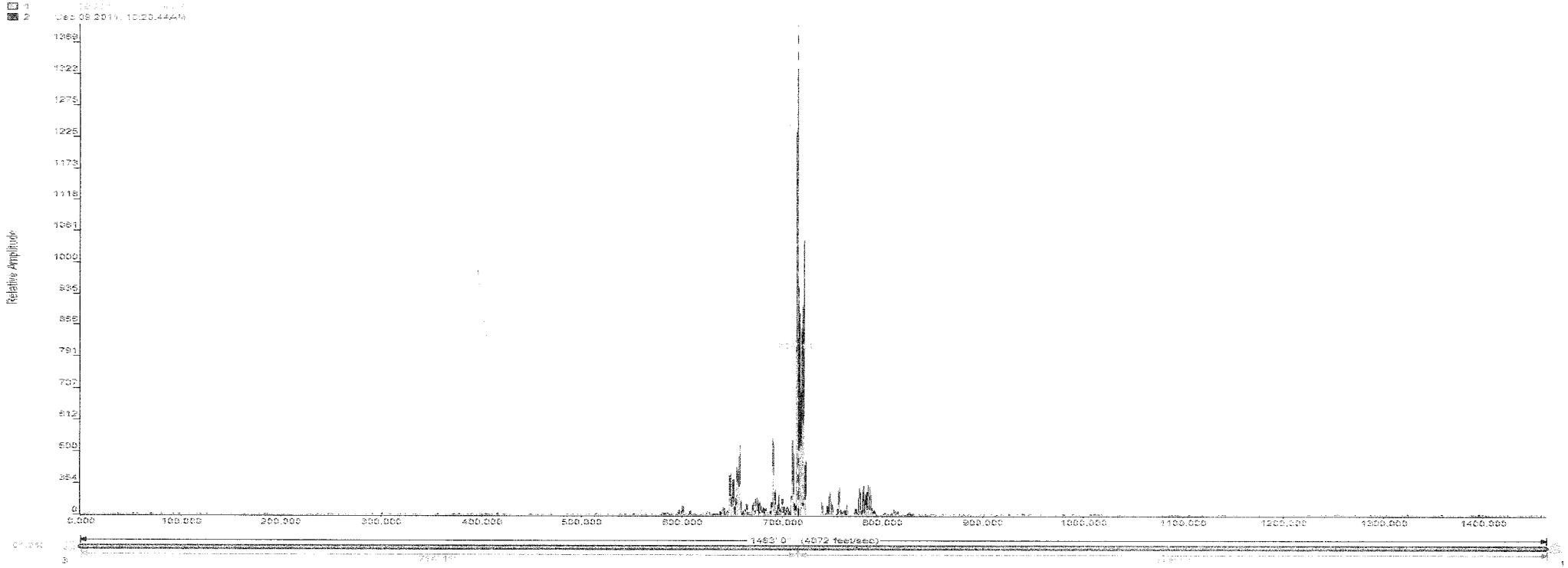
Estimated Leakage

10 GPM

Leak Pipe Material



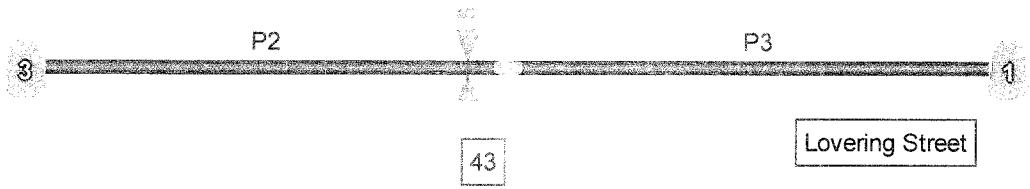
Remarks Leak was Correlated and Found to be on the Service to 43 Levering Street Long Side



Memory Lane

Pipe ID	Length	Diameter	Material	Sound Velocity
P2	778' 0"	6"	Cast Iron	4072 feet/sec
P3	685' 0"	6"	Cast Iron	4072 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	713' 4" from 3	3 -> 2	88.7%	Dec 09 2011, 10:15:44AM
L2	713' 10" from 3	3 -> 2	88.6%	Dec 09 2011, 10:20:44AM
L3	713' 10" from 3	3 -> 2	89.7%	Dec 09 2011, 10:25:44AM
L4	714' 11" from 3	3 -> 1	91.2%	Dec 09 2011, 10:25:44AM
L5	714' 11" from 3	3 -> 1	92.0%	Dec 09 2011, 10:20:44AM
L6	714' 11" from 3	3 -> 1	91.2%	Dec 09 2011, 10:25:44AM



Liston Utility Services

19 Mauriello Drive, Stoneham, MA 02801-2775

Phone 781 635 7711 **Fax 781 435 1480**

Page No. 4

Date December 12, 2011

Ownership Public Private Easement

Leak Indication classification

(I C) II B III A

Leakage Control Report
Water Report

Weather

Company **Town of Medway** Address **155 Village Street**

City **Medway** State **Massachusetts** **02053**

Address 60 Winthrop Street

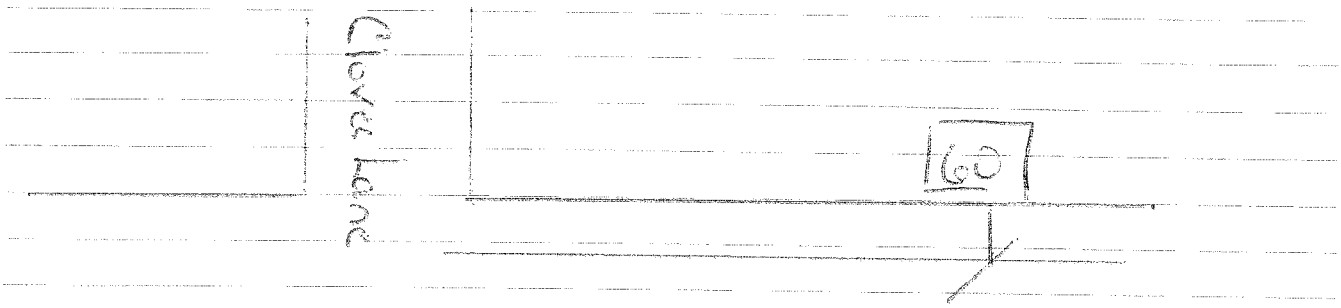
N

Indication of Leak		Leak Detected at:		Leak appears to be on		Cover	
Sonic	X	Main Valve	X	Main		Concrete	
Surfaced Water		Curb Valve		Service	X	Asphalt	X
Correlation	X	Meter Box		Joint Connection		Brick	
		Selected Test		Hydrant		Gravel	
		Hydrant	X	Valve		Soil	
				Misc		Other	

Estimated Leakage

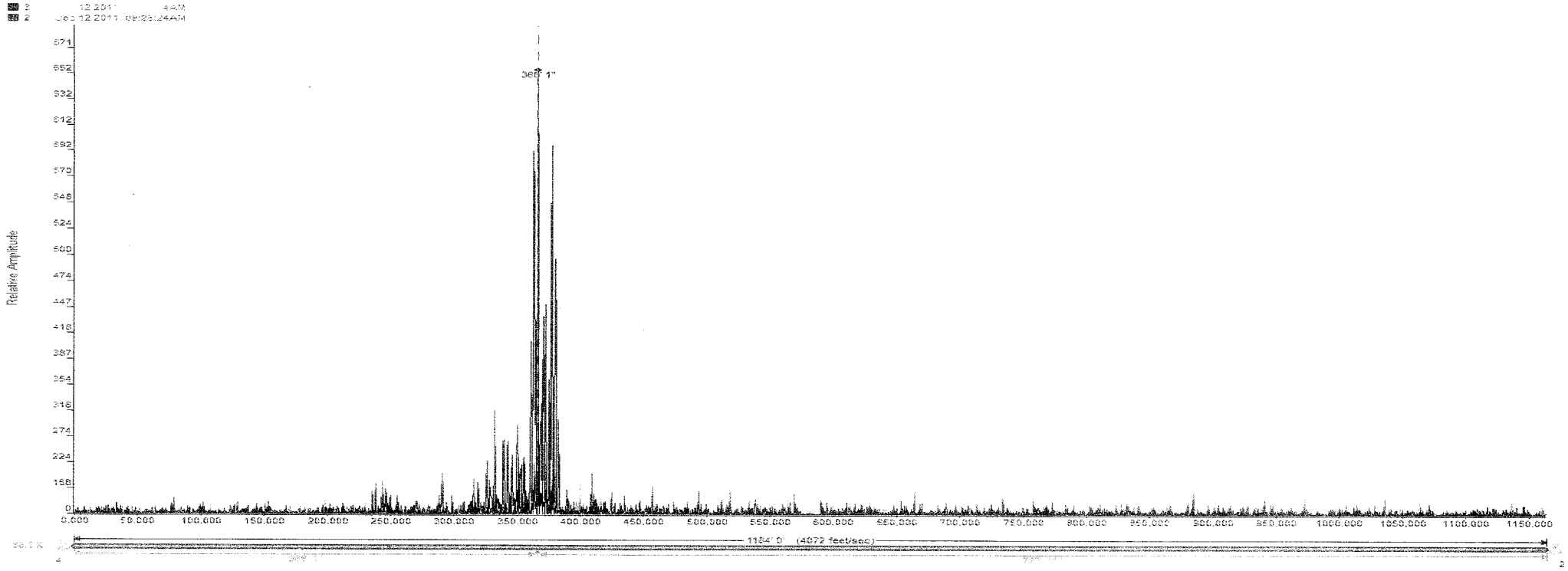
11 GPM

Leak Pipe Material



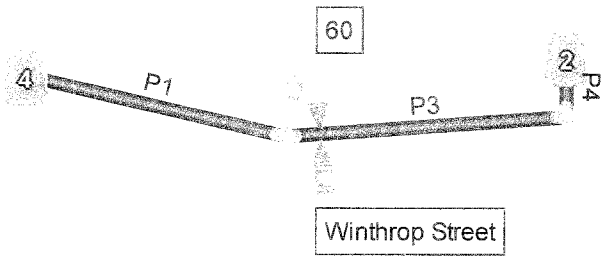
Remarks Leak was multi-correlated and found to be on the service to 60 Winthrop Street

Short side



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	252' 0"	6"	Cast Iron	4072 feet/sec
P3	910' 0"	6"	Cast Iron	4072 feet/sec
P4	2' 0"	6"	Cast Iron	4072 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L2	251' 1" from 4	4 -> 3	77.5%	Dec 12 2011, 09:26:24AM
L4	370' 9" from 4	4 -> 2	77.7%	Dec 12 2011, 09:31:24AM
L5	366' 6" from 4	4 -> 2	75.3%	Dec 12 2011, 09:26:24AM
L6	366' 1" from 4	4 -> 2	86.5%	Dec 12 2011, 09:21:24AM



Attachment C: Residential Meter Error per a Previously Conducted Water Audit

Residential meters in the Medway system include a basic water meter, usually located in the basement, and box register located outside the house. The outdoor register or "Box" provides the numbers that the meter reader records manually. The box shows total cubic feet in 100-cubic foot increments. The outdoor register operates through a wire connected to the meter inside the house. At every 100 cubic feet, a pulse is transmitted through the wire and the outdoor register indexes one digit.

41 data sets were tabulated and the outside reader compared to the inside meter. The difference between the two readings was calculated as a percentage of the inside meter reading. Within the 41 meters sampled the outdoor registers under read the metered volume by 9.7%.

Liston Utility Services

19 Mauriello Drive, Stoneham, MA 02801-2775

Phone 781 635 7711 **Fax 781 435 1480**

Page No. 5

Date December 8, 2011

Ownership (Public) Private Easement

Leak Indication classification

I C II B (III A)

Leakage Control Report
Water Report

Weather

Company **Town of Medway** Address **155 Village Street**

City **Medway** State **Massachusetts** **02053**

Address 15 Delmar Road

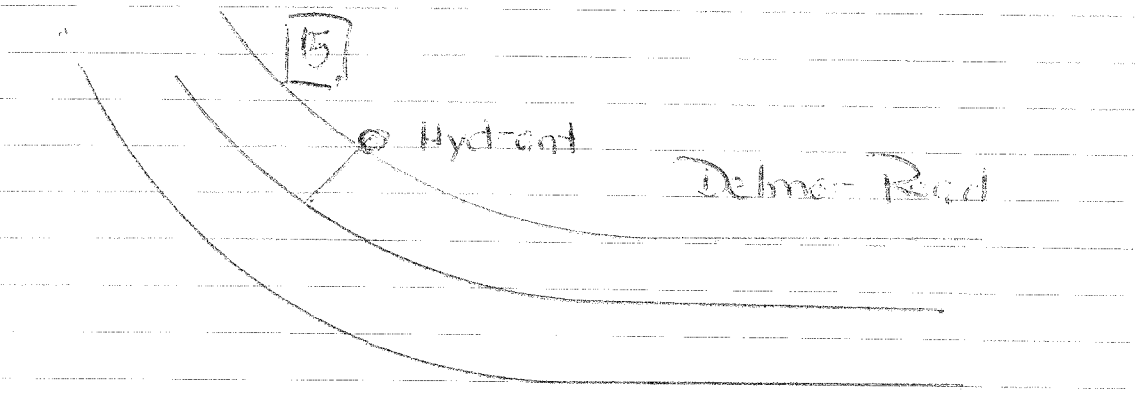
N

Indication of Leak		Leak Detected at:		Leak appears to be on		Cover	
Sonic	X	Main Valve		Main		Concrete	
Surfaced Water		Curb Valve		Service		Asphalt	
Correlation		Meter Box		Joint Connection		Brick	
		Selected Test		Hydrant	X	Gravel	
		Hydrant	X	Valve		Soil	X
				Misc		Other	

Estimated Leakage

1 GPM

Leak Pipe Material



Remarks Leak was sonically located on the hydrant at 15 Delmar Road

RADCOM
TECHNOLOGIES LTD

User Guide

RADCOM
TECHNOLOGIES LTD

Radcom Technologies Ltd
Sentry House
10 Romsey Industrial Park
Greatbridge Road
Romsey Hampshire UK
SO51 0HR

Tel: +44 (0)1794 528 700
Fax: +44 (0)1794 528 760

Record of Amendments

Keep this record in the front of the User Manual. When the document has been amended write the amendment number, the date, the paragraph numbers affected by the amendment and your initials in the table below.

Amendment Number	Amendment Date	Reason for Re-Issue (Paragraph Number (s) Amended)	Amended by
1.0	9 July 2007	First draft	AMB
1.1	18 July 2007	Issued	AMB
1.2	16 Jan 2008	Added information about charging	AMB
1.3	28 May 2008	Added more information about changing default sensor type	AMB
1.4	2 July 2008	Added information about daisy chaining cases together	AMB

Contents

Introduction

Components

SoundSens correlation pods
SoundSens carry case
Software CD
Mains charger
Download leads
(1 x Serial, 1 x USB)

Concept

The SoundSens system comprises a powerful software package and the new SoundSens i pods which can be setup in the field with or without a PC. Recordings can be stored in the memory of the pod, or the unit can be used with a PC to correlate in the field as a multipoint unit carrying out the test straight away or as a delayed test ie: over night.

SoundSens i can store four sets of recording sessions. This is equivalent to 4 nights of data storage. The SoundSens PC software contains help files for using the PC to setup, download and analyse recordings.

This manual was written using SoundSens software version 3.2.1 and Radcom SoundSens i sensors.

Charging the Carry Case

The carry case contains rechargeable batteries. It must be charged for 24 hours before first use. Re-charge the carry case when the battery status LED starts to flash RED. The data will be lost if the unit goes completely flat. However the battery low LED will give plenty of notice of a low battery (i.e. days) and should be seen as an indication to download data and re-charge.

The charge in the carry case battery pack should last approximately two months depending on how frequently it is used.

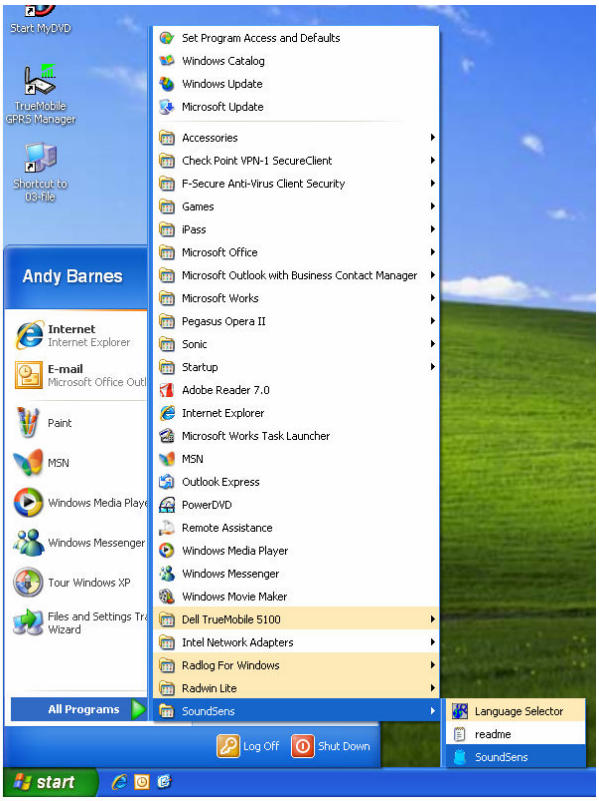
To charge the batteries plug the supplied mains charger into the charging socket next to the battery status LED. While charging the LED will flash ORANGE.

When the batteries are charged the battery status LED will flash GREEN (even if the charger is still connected).

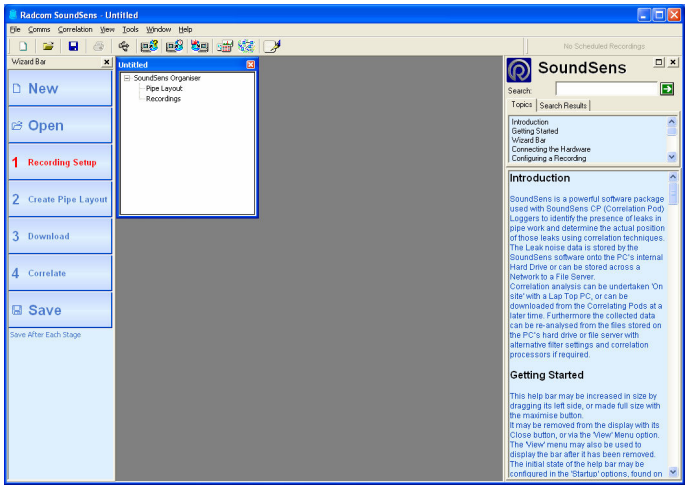
Setting Up SoundSens

Setup With PC

Start the software



Run the SoundSens software from the Start menu as illustrated here.



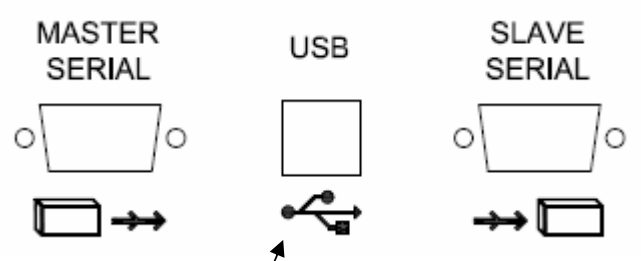
The opening screen for the SoundSens software.

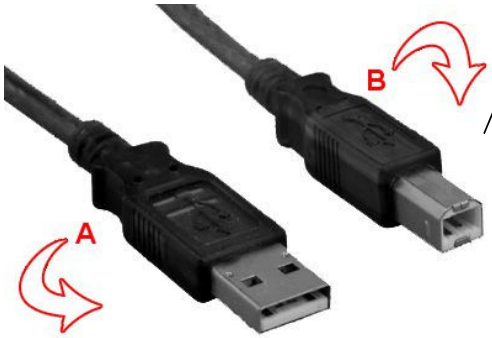
Connect the carry case to the PC

Serial (RS232) Communication Cable

The male end of the cable plugs into the Master Serial connector on the carry case, and the female end plugs into your laptop or PC.

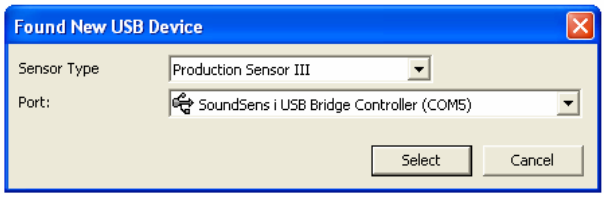
See next page for further information





USB Communication Cable

The A end (rectangle shape) plugs into your PC or laptop, and the B end (square shape) plugs into the USB connector on the carry case.

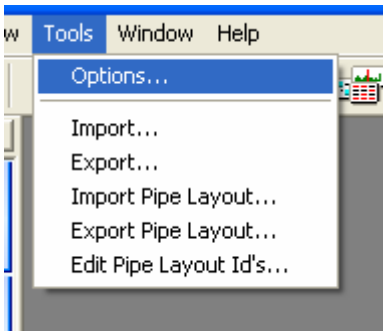


This message will appear indicating the software has detected the case

See next page for further information

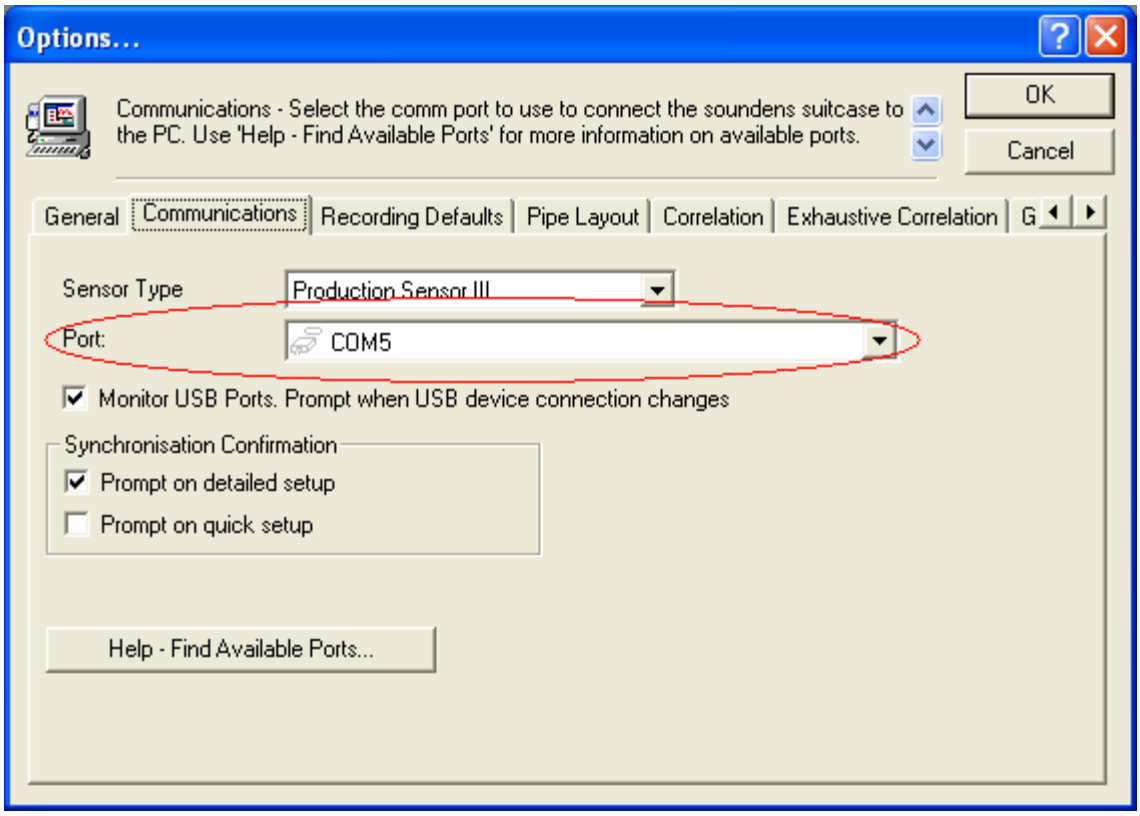
Information regarding connection via Serial RS232

When you connect the carry case to your laptop or PC via the Serial (RS232) cable the PC will not do anything. You must select the correct communications port manually.



From the Tools menu click Options

Then select the Communications tab (see below)

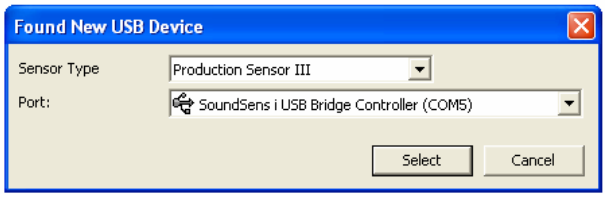


Select the correct port from the drop down list.

For extra help please see page 54 or contact the Radcom technical support team.

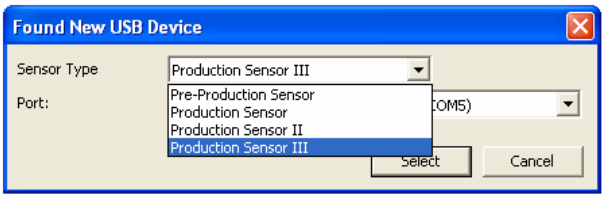
Information regarding connection via USB

With the software started connect the SoundSens carry case to the PC using the USB communication cable.



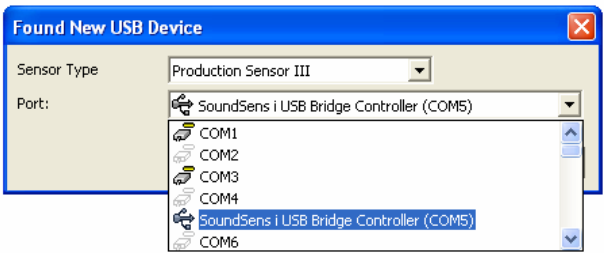
This message will appear indicating the software has detected the case.

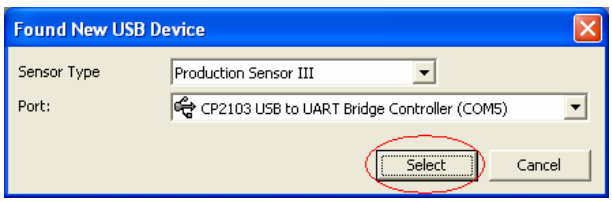
On the Sensor Type drop down menu you can select the following



- Pre Production Sensor
- Production Sensor (The original SoundSens logger)
- Production Sensor II (Dark blue plastic logger)
- Production Sensor III (Otherwise known as SoundSens i)

The port drop down menu is usually picked automatically.





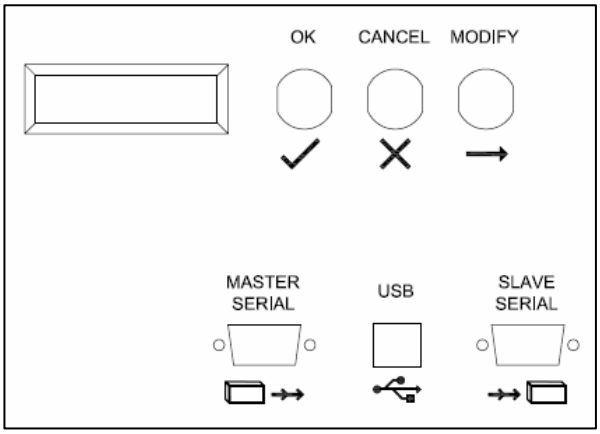
Click Select to continue.

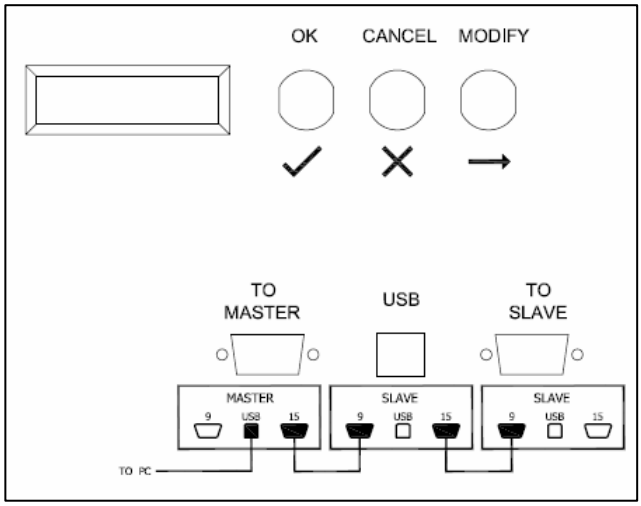
Information regarding daisy chaining multiple cases together

To communicate with multiple cases you need to connect them together using SoundSens serial communication cables, and then via USB to the PC.

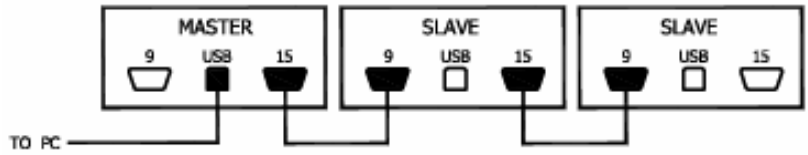
The suitcase lid will have an arrangement of D shape communication ports and a USB port.

There are variations on the lid as shown below.



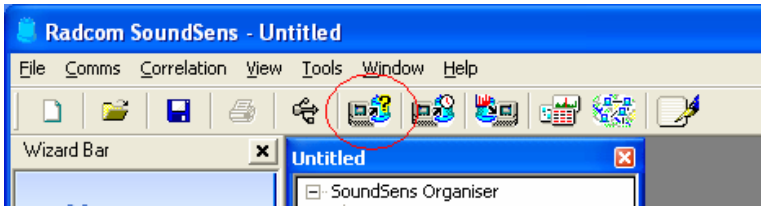


In all situations you need to daisy chain the cases as shown below.

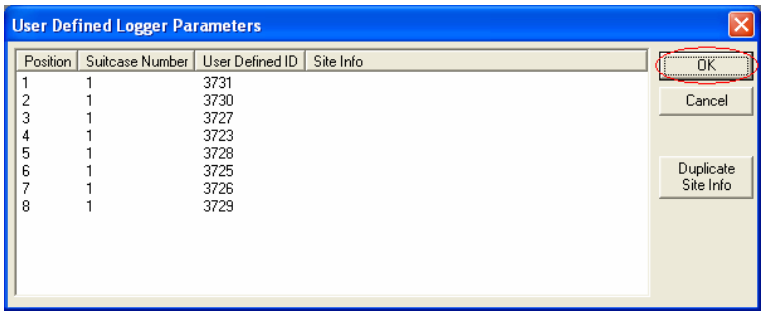


Note: You can not chain together 4 pod kits, but one 4 pod kit can be connected to the end of a chain of 8 or 6 pod kits.

Communication Test



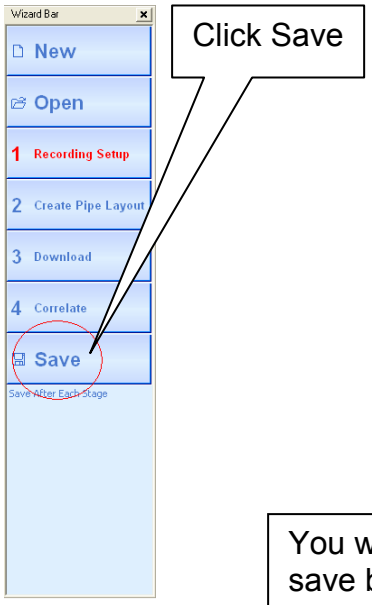
With the carry case (or cases) connected to your PC or Laptop click the sixth icon on the menu bar.
The software will now communicate with the case (or cases) and loggers.



The list which pops up shows the logger positions in the case. If any loggers have failed to communicate they will be missing from this list.

Click Ok.

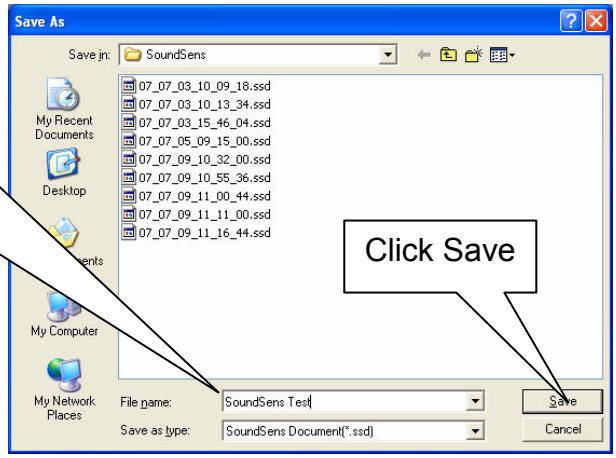
REMEMBER TO SAVE REGULARLY



Click Save

Type a name for your file.

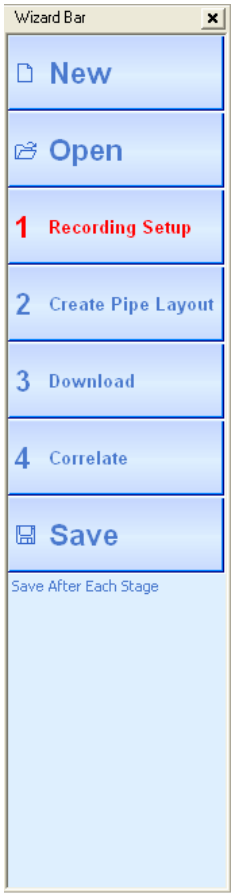
Make sure the file name has not been used before.

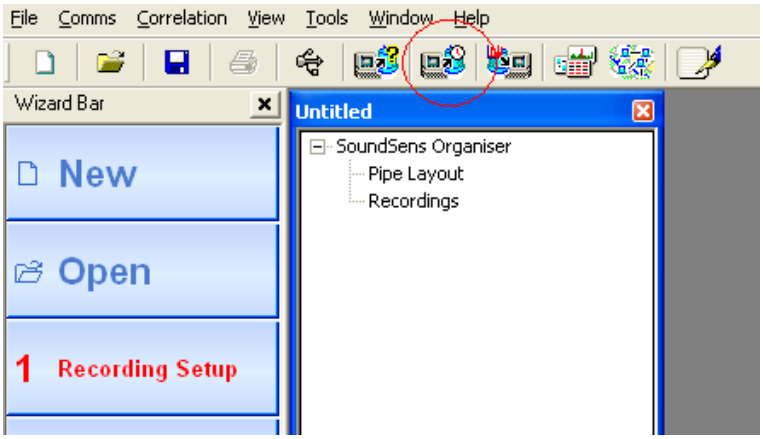


You will only be prompted to type a file name if you have not clicked save before.

Every other time you click save the updates will be saved but no other action will be required.

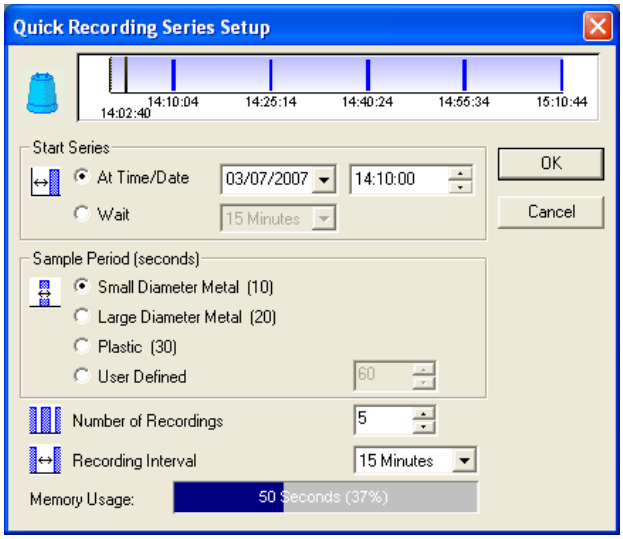
Quick recording setup





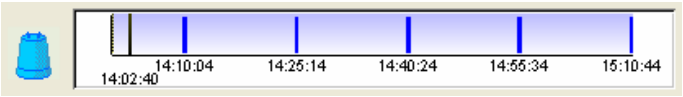
Connect the carry case to your PC or Laptop.

To setup a quick recording either click the Recording Setup button on the Wizard Bar (left image), or click the 7th button on the menu bar (circled above).



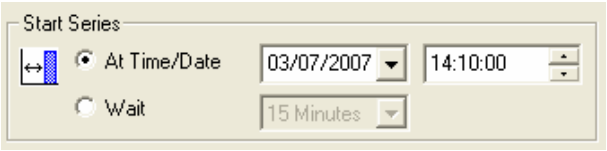
This is the Quick Recording Series Setup window which will pop up after clicking the Recording Setup button.

Quick recording setup is explained in detail next.

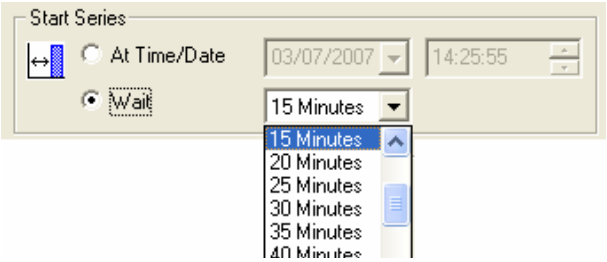


The time line shows a series of logging sessions as dark blue lines. (SEE DIAGRAM BELOW)

If the time line is red then check the "Start Series At Time/Date" values are not in the past (SEE NEXT DIAGRAM).

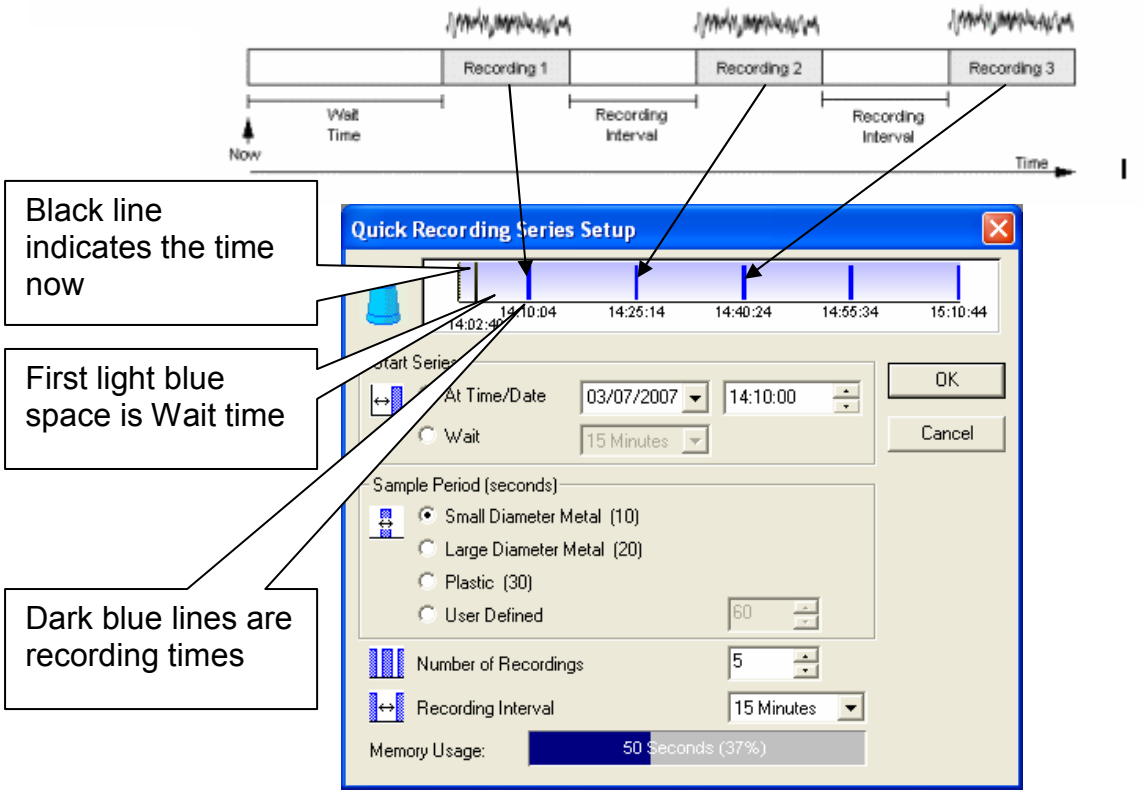


It is possible to set a date and time for the recording series to start
NOTE : Do not set a start time more than 36 hours in the future.



Alternativly you can set the loggers to wait for a period of time before starting.
You can set the waiting time between 1 minute and 3 hours.

Make sure you have sufficient time to deploy the pods before the run starts!

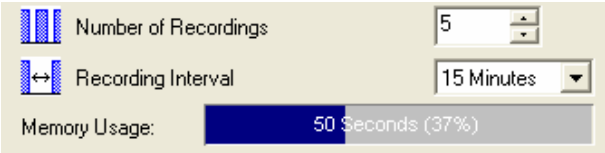


Select the sample period.
This is determined by the pipe material and diameter.

Suggested sample periods for pipe materials and lengths are shown below.

Pipe	Short distances	Metre	Long distances	Metre	Very long distances	
Up to 6" Metal	10 Seconds	500	10-20 Seconds	1000		
8" +Metal	20 Seconds	400	20-30 Seconds	800		
Up to 6" AC	10 Seconds	100	20 Seconds	500		
8"+ AC	20 Seconds	80	30 Seconds	500		
Up to 4"MDPE?PVC	30 Seconds	50	60 Seconds	100		
4" + MDPE/PVC	60 Seconds	50	120+Seconds	100		
300+Steel			20 Seconds	500	60 Seconds	1000+

NOTE : On sites with mixed pipe material always select the longest sample period. So if you have some 6" and some 8" Metal (less than 500 metre lengths) select 20 seconds.



Set the number of recordings (max 9), and set the recording interval (between 1 minute and 3 hours)

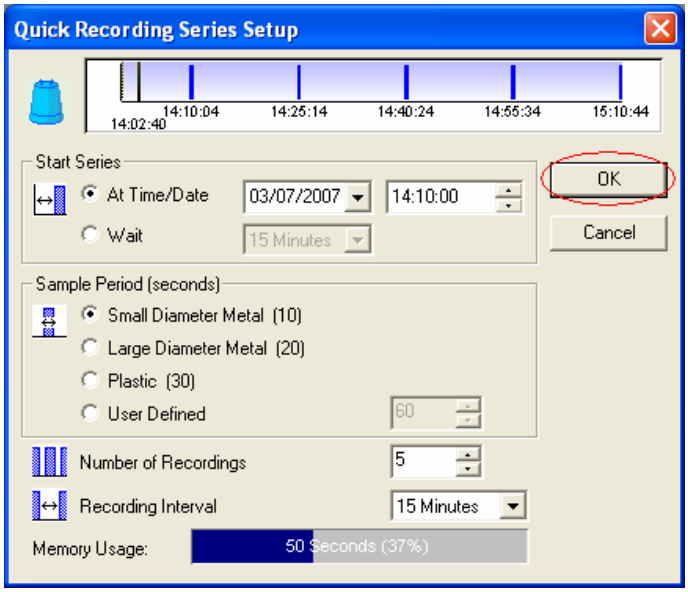
The recording interval is the gap between the START times of each recording.
e.g. if three recordings of 1 minute each are set to start at 1AM with a recording interval of 1 hour then the start times will be 1am, 2am, 3am. If the recording interval is 15 minutes then the start times will be 1am, 1:15am and 1:30 am.

Radcom recommends 3 recordings – see explanation below.

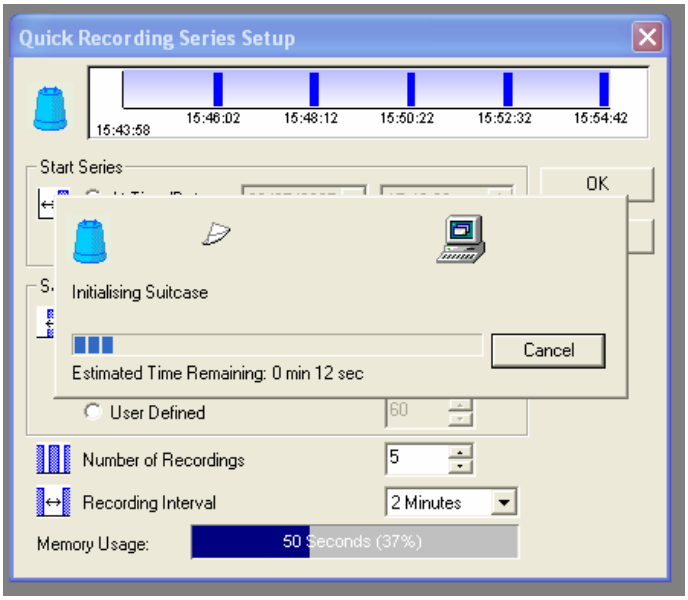
The recording interval needs to be set with local knowledge in mind. Think of how long it takes for a toilet to fill in your local area, and set the recording interval to that time. This will help reduce the detection of noise which is due to legitimate consumption.

This is also partly the reason why we suggest 3 recordings. If a logger detects a noise which can be put down to legitimate usage then hopefully on the second or third recording the usage will have stopped.

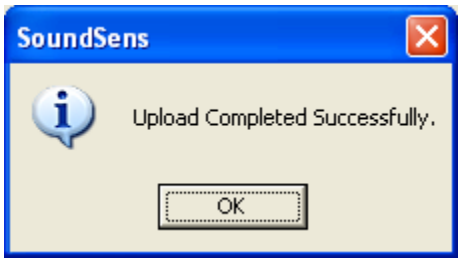
Some combinations of sample periods and number of recordings will cause excess memory usage. This is due to memory size restrictions in the logger.



After you are happy with the settings in the setup window, click OK.



The SoundSens software should communicate with the suitcase.



The SoundSens software will display this message if the setup worked. Click OK to continue.

Deploy SoundSens correlation pods (i.e. loggers) on site.
You should have sufficient time to deploy the pods before the run starts.
As you deploy make a note of the SERIAL NUMBER of the Pod and it's location on site.

CONTINUED…

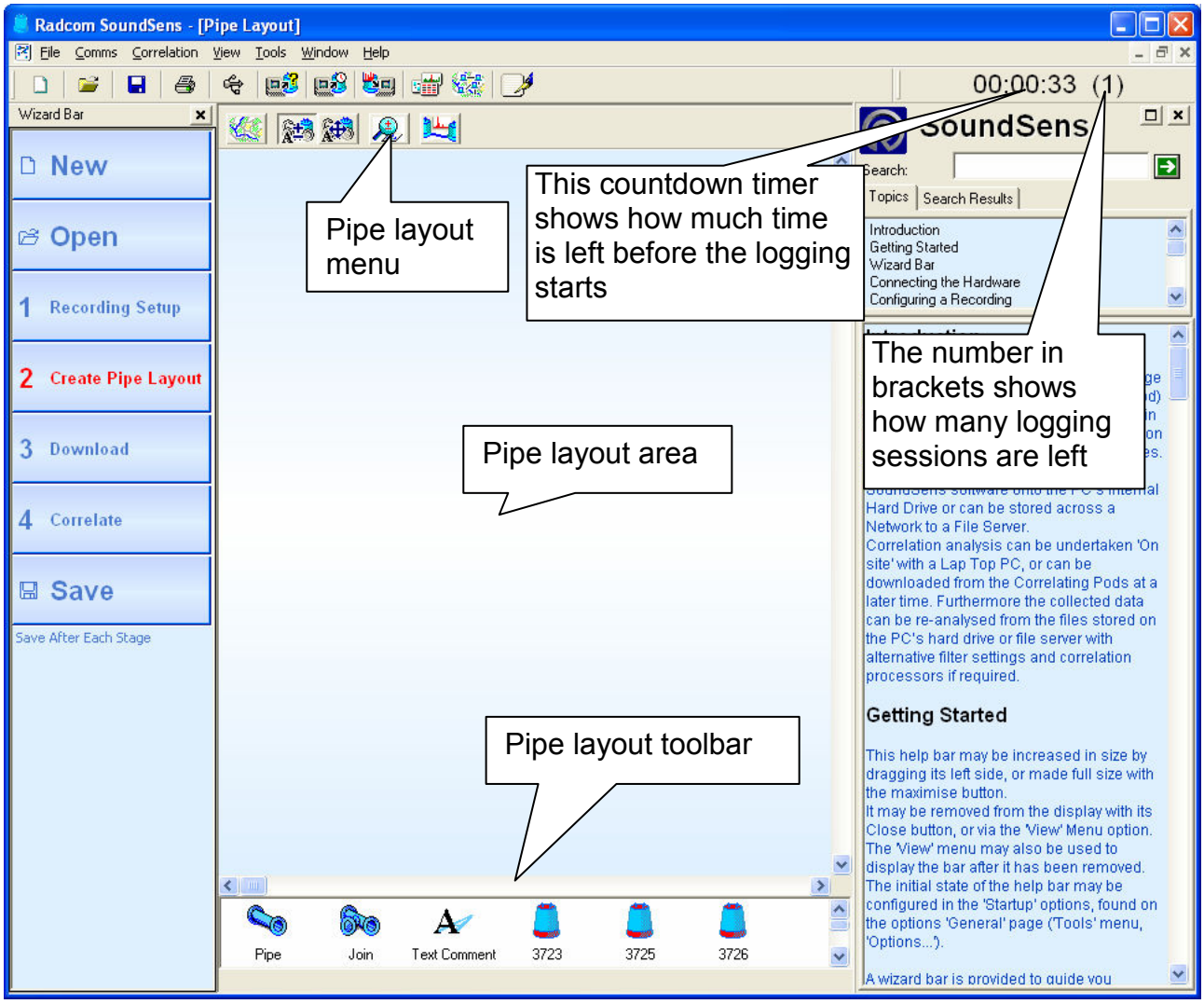
Quick recording setup with Multiple Cases

Connect the suitcases together as shown in the section “Information regarding daisy chaining multiple cases together”

Follow the instructions from the section “Quick recording setup”.

At the stage of upload you will notice the software communicates with each suitcase and each logger within in turn.

After uploading the settings to the loggers the SoundSens software will look something like this…



The next step is to create a pipe layout.

Creating a pipe layout is explained in the Pipe Layout section within the Dealing With Data chapter of this manual.

REMEMBER TO SAVE REGULARLY (PAGE 8)

Setup Without PC

Basic Carry Case Operation

Please note
When the carry case is not being used it will switch to a low power standby mode for battery conservation, so the carry case display will turn off after 20 seconds if no buttons are pressed. If you are in the middle of making any changes or setting up a recording session you will have to start again.

The carry case display can be reactivated by pressing OK, CANCEL, or MODIFY. The first thing you see on the display will always be the time and date – **You must check that this is correct before setting up a recording**. However the chances of the time being wrong are very small because every time the SoundSens software communicates with the carry case it will synchronise the time.

In addition to the time/date this screen can also show

- BATTERY LOW (if the battery needs charging)
- BATTERY CHARGING (when the charger is plugged in)
- Recording countdown (time until next recordings starts) if neither of the above apply and a recording has been set up.

The format for the recording countdown is: HH:MM:SS (N)

HH – Hours
MM – Minutes
SS – Seconds
N – Number of recordings remaining

Pressing the MODIFY key cycles through the main options.
To select an option press OK.
Pressing CANCEL returns to the time/date screen.

Main options (Press Modify to cycle through):

- Time/Date
- Set recording 1? (30min delay) – daytime quick recording setup
- Set recording 2? (2am start) – overnight quick recording setup
- Recording setup? – Custom recording setup
- Download data?
- Stored data
- Set time/date

Set Time / Date

Setting the time is rarely necessary as the unit contains an accurate clock, and when connected to a PC the time and date are updated.

1. Press MODIFY to cycle through the menu options until you see "**Set Time / Date**"
2. Press OK to enter edit mode
3. Use the MODIFY key to change the value
4. Press OK to move to the next value

Recording options

There are three options for setting up a new recording.

1. Daytime Quick Recording
2. Overnight Quick Recording
3. Custom Recording

This table should assist you in deciding weather one of the pre-programmed sessions will be suitable, or if you need to set up a custom recording.

Pipe	Short distances	Metre	Long distances	Metre	Very long distances	
Up to 6" Metal	10 Seconds	500	10-20 Seconds	1000		
8" +Metal	20 Seconds	400	20-30 Seconds	800		
Up to 6" AC	10 Seconds	100	20 Seconds	500		
8"+ AC	20 Seconds	80	30 Seconds	500		
Up to 4"MDPE?PVC	30 Seconds	50	60 Seconds	100		
4" + MDPE/PVC	60 Seconds	50	120+Seconds	100		
300+Steel			20 Seconds	500	60 Seconds	1000+

Daytime Quick Recording Setup

This sets up a recording session which will start after a 30 minute delay. Three recordings will be made each 20 seconds long, five minutes apart.

Delay to start of recording:	30 min
Interval between recordings:	5 min
Length or each recording:	20 sec
Number of recordings:	3

Check the table at the bottom of this page to see if it is suitable for your test.

1. Press MODIFY to cycle through the menu options until you see "**Set recording 1**"
2. Press OK to setup the quick recording

If the loggers contain any data then it will be downloaded before the new recording is set up. This ensures that the data in the loggers cannot be lost accidentally by setting up a new recording. All recordings will be available for download in the SoundSens software.

When the recording setup is complete the screen will show a confirmation message, e.g.

The number of loggers programmed is displayed, and the right side of the screen shows a map of the positions of the programmed pods ('O' represents a logger present and a '-' shows a vacant position). If this differs from the actual positions of the loggers below the most likely explanation is that the windows on top of the pods are dirty or that an object is on top of the loggers.

Pipe	Short distances	Metre	Long distances	Metre	Very long distances	
Up to 6" Metal	10 Seconds	500	10-20 Seconds	1000		
8" +Metal	20 Seconds	400	20-30 Seconds	800		
Up to 6" AC	10 Seconds	100	20 Seconds	500		
8"+ AC	20 Seconds	80	30 Seconds	500		
Up to 4"MDPE?PVC	30 Seconds	50	60 Seconds	100		
4" + MDPE/PVC	60 Seconds	50	120+Seconds	100		
300+Steel			20 Seconds	500	60 Seconds	1000+

Overnight Quick Recording Setup

This sets up a recording session which will start at 2am. Three recordings will be made each 20 seconds long, one hour apart.

Recording start time:	2 am
Interval between recordings:	1 hour
Length or each recording:	20 sec
Number of recordings:	3

Check the table at the bottom of this page to see if it is suitable for your test.

1. Press MODIFY to cycle through the menu options until you see "**Set recording 2**"
2. Press OK to start the recording setup

If the loggers contain any data then it will be downloaded before the new recording is set up. This ensures that the data in the loggers cannot be lost accidentally by setting up a new recording. All recordings will be available for download in the SoundSens software.

When the recording setup is complete the screen will show a confirmation message, e.g.

```
4 LOGGERS    -O--
PROGRAMMED   -OOO
```

The number of loggers programmed is displayed, and the right side of the screen shows a map of the positions of the programmed pods ('O' represents a logger present and a '-' shows a vacant position). If this differs from the actual positions of the loggers below the most likely explanation is that the windows on top of the pods are dirty or that an object is on top of the loggers.

Pipe	Short distances	Metre	Long distances	Metre	Very long distances	
Up to 6" Metal	10 Seconds	500	10-20 Seconds	1000		
8" +Metal	20 Seconds	400	20-30 Seconds	800		
Up to 6" AC	10 Seconds	100	20 Seconds	500		
8"+ AC	20 Seconds	80	30 Seconds	500		
Up to 4"MDPE?PVC	30 Seconds	50	60 Seconds	100		
4" + MDPE/PVC	60 Seconds	50	120+Seconds	100		
300+Steel			20 Seconds	500	60 Seconds	1000+

Custom Recording Setup

This option sets up a recording with user-defined settings.

1. Press MODIFY to cycle through the menu options until you see "**Recording Setup**"
2. Press OK to start
3. For each setting number use the MODIFY key to change the value
4. Press OK to move to the next setting

The options available are:

1. Recording Start Delay
    - 1,5,10,15,30 or 60 minutes
    - At the beginning of an hour (press modify to cycle through)

2. Length Of Each Recording
    - 10, 20, 30 or 60 seconds

3. Recording Interval (time between recordings)
    - 1, 2, 5, 10, 15, 20, 30, 45 or 60 minutes

4. Number Of Recordings
    - 10, 20, 30 or 60 seconds

This table should assist in selecting the recording options you need.

Pipe	Short distances	Metre	Long distances	Metre	Very long distances	
Up to 6" Metal	10 Seconds	500	10-20 Seconds	1000		
8" +Metal	20 Seconds	400	20-30 Seconds	800		
Up to 6" AC	10 Seconds	100	20 Seconds	500		
8"+ AC	20 Seconds	80	30 Seconds	500		
Up to 4"MDPE?PVC	30 Seconds	50	60 Seconds	100		
4" + MDPE/PVC	60 Seconds	50	120+Seconds	100		
300+Steel			20 Seconds	500	60 Seconds	1000+

NOTE : On sites with mixed pipe material always select the longest sample period. So if you have some 6" and some 8" Metal (less than 500 metre lengths) select 20 seconds.

The recording interval needs to be set with local knowledge in mind. Think of how long it takes for a toilet to fill in your local area, and set the recording interval to that time. This will help reduce the detection of noise which is due to legitimate consumption.

This is also partly the reason why we suggest 3 recordings. If a logger detects a noise which can be put down to legitimate usage then hopefully on the second or third recording the usage will have stopped.

Continued…

For the last setting, ‘number of recordings’, if a value is selected that uses more than the available memory in the logger then exclamation marks will be shown as a warning. For example if the recoding length is set to 60 seconds and the number of recordings is set to 4 then the display will show:

```
NUMBER OF
RECORDINGS:4 !!
```

The exclamation marks show that the logger memory will overflow if this combination of settings is used. In this situation, use a lower number of recordings or a shorted recording time.

If the loggers contain any data then it will be downloaded before the new recording is set up. This ensures that the data in the loggers cannot be lost accidentally by setting up a new recording. All recordings will be available for download in the SoundSens software.

Downloading Data To The Carry Case

Data can be held in the carry case and downloaded to a PC or Laptop at a later stage. To download data after a recording:

1. Place the pods back into the case (in any order or position) and lower the front panel.
2. Press MODIFY to cycle through the menu options until you see "**Download Data**"
3. Press OK to start the download

A message will be displayed during data transfer. After downloading data from the pods a confirmation message is shown. This is the same format used after setting up a recording and shows which loggers have transferred data.

Viewing Stored Data Details

This option shows a summary of data sets stored in the SoundSens i. A 'set' is the collection of data transferred during a download. The summary shows the set number, number of pods used and the start time of the first recording, e.g.

1. Select the **Stored Data?** option with MODIFY
2. Press OK to view the summary for the first set
3. Press OK to view the next set

When all sets have been displayed there is an option to delete the last set. Note the delete operation **cannot be undone**.

1. Select the **Stored Data?** option with MODIFY
2. Press OK until all the sets have been seen and the message "Remove last set" is shown

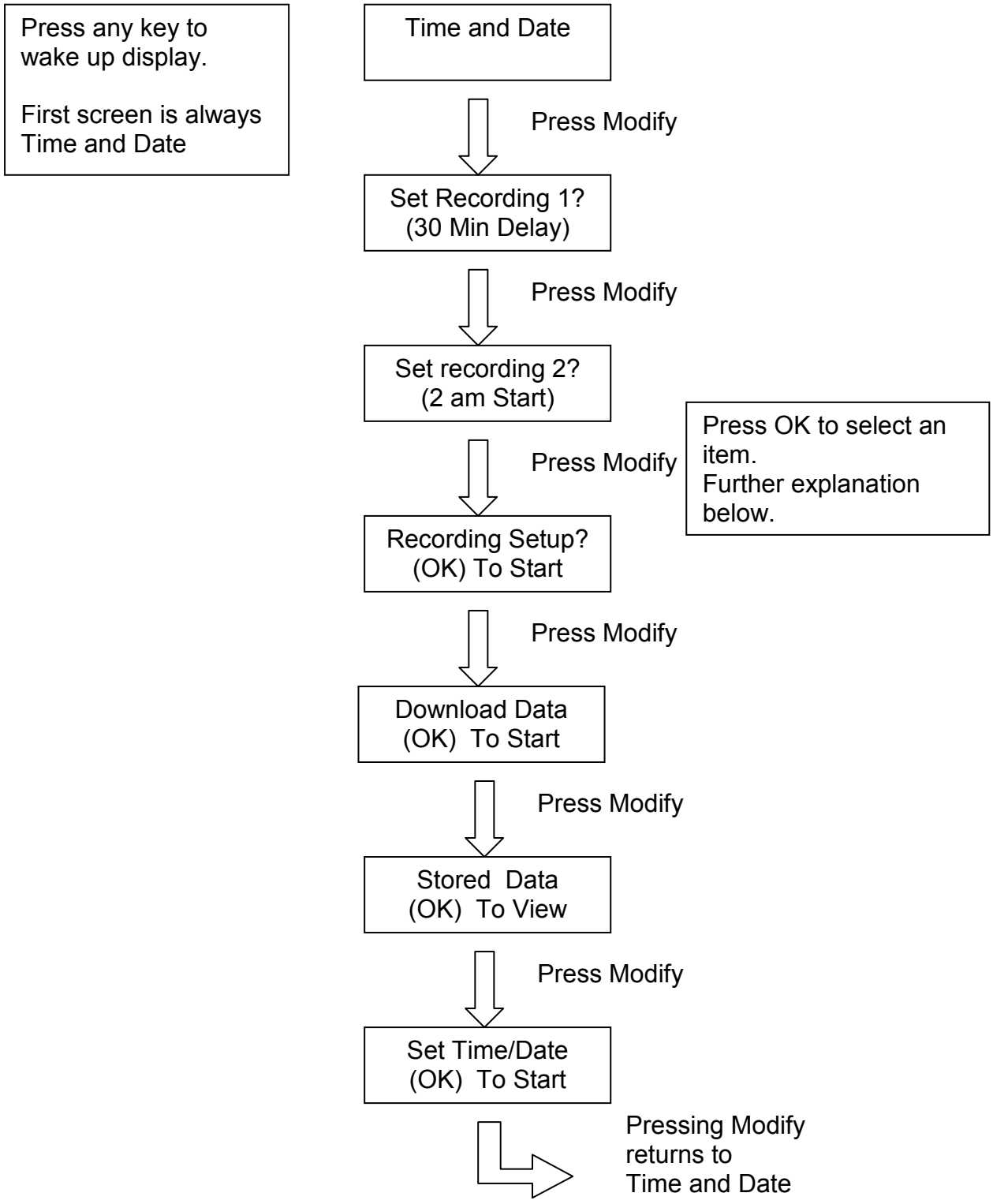
To delete the data use the MODIFY key to select YES then press OK

Memory Capacity

There is enough memory in the case to hold 4 downloads from 8 SoundSens i correlator pods which are full of data. When the case and all the pods are full of data you will not be able to record any more and you will see "Memory Full" on the display. Either download the data to a PC or erase some data from the View Data menu.
One pod will hold approximately 120 seconds of data.

SoundSens Case User Interface

Summary



Set Recording 1 (30 Minute Delay)

Set Recording 1 (30 Min Delay)

Press any key to wake up display.
Time and Date should be displayed.

Press MODIFY once
Display should read…

Set Recording 1?
(30 Min Delay)

→ Press **OK**

A recording session will be set up with the following settings…

3 Recordings
20sec Duration
5 min Intervals

This is not shown on the display.

↓ The display will show

Setting up recordings

↓ Followed by

8 Loggers 0000
Programmed 0000

The number of loggers programmed depends on the number of loggers in the case.
Each 0 shown on the right represents a logger in the case.

The display will then change to a countdown timer showing the time until the recording starts and the number of recordings left (number in brackets).

↓

14 :31 04/02/07
Rec 00:00:00 (3)

If a recording is taking place then the display will show the following message.

↓

14 :31 04/02/07
Recording in progress

Please Note:
When the loggers have been programmed the display will switch off after 20 seconds to save battery power.

Wake up the display by pressing any key. It should show the current recording session countdown time, or the time and date if recordings have finished.

Set Recording 2 (2am Start)

Set Recording 2 (2 am Start)

Press any key to wake up display.
Time and Date should be displayed.

Press MODIFY twice
Display should read…

Set recording 2?
(2 am Start)

→ Press **OK**

A recording session will be set up with the following settings…

3 Recordings
20sec Duration
1 hour Intervals

This is not shown on the display.

The display will show

Setting up recordings

Followed by

8 Loggers 0000
Programmed 0000

The number of loggers programmed depends on the number of loggers in the case.
Each 0 shown on the right represents a logger in the case.

The display will then change to a countdown timer showing the time until the recording starts and the number of recordings left (number in brackets).

14 :31 04/02/07
Rec 00:00:00 (3)

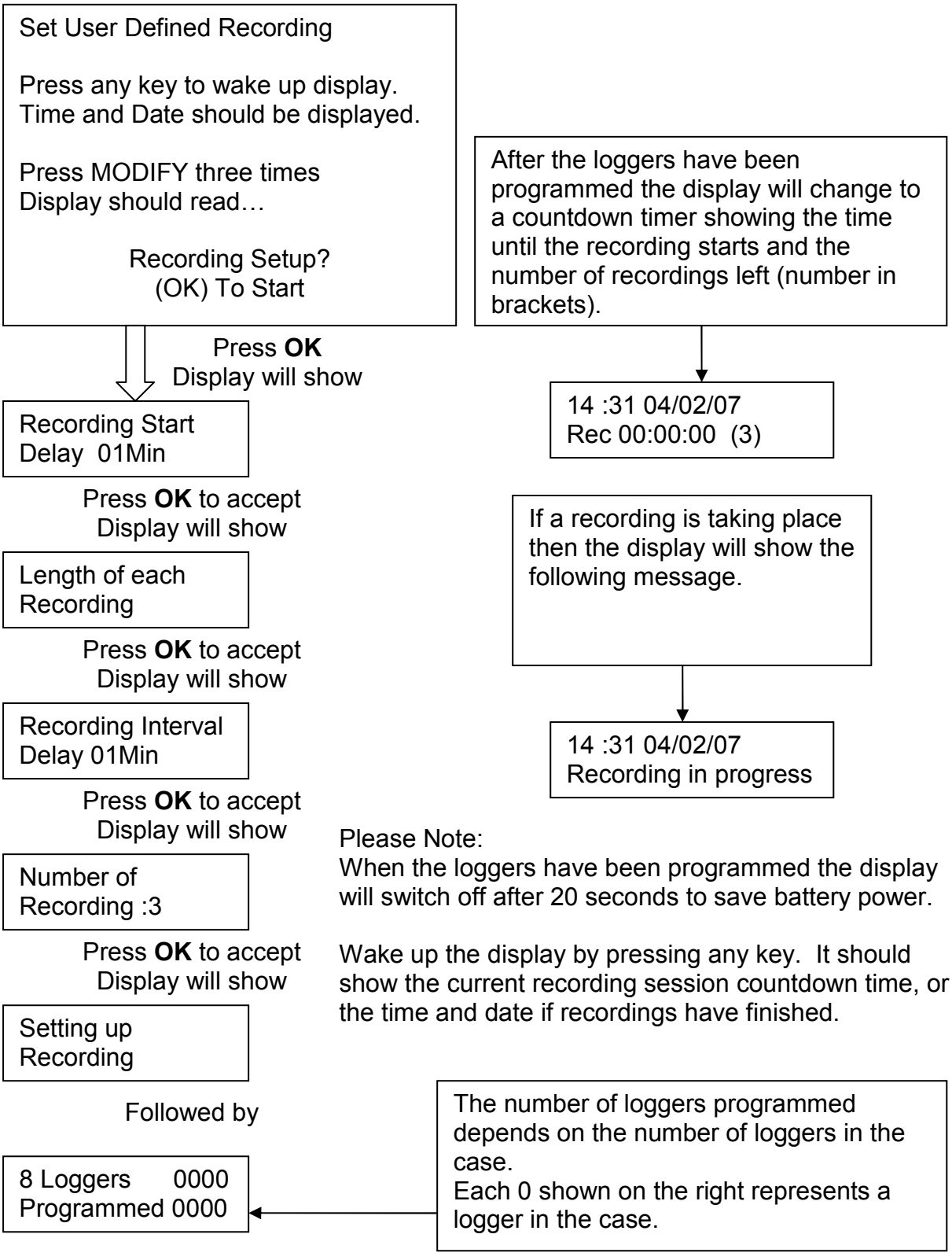
If a recording is taking place then the display will show the following message.

14 :31 04/02/07
Recording in progress

Please Note:
When the loggers have been programmed the display will switch off after 20 seconds to save battery power.

Wake up the display by pressing any key. It should show the current recording session countdown time, or the time and date if recordings have finished.

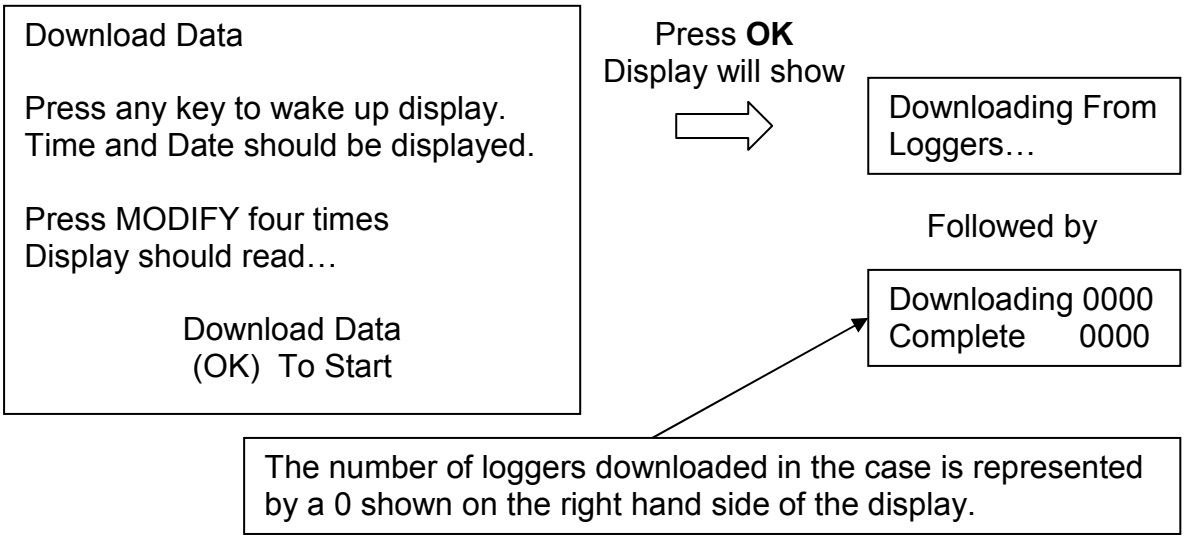
Set User Defined Recording



Please Note:
When the loggers have been programmed the display will switch off after 20 seconds to save battery power.

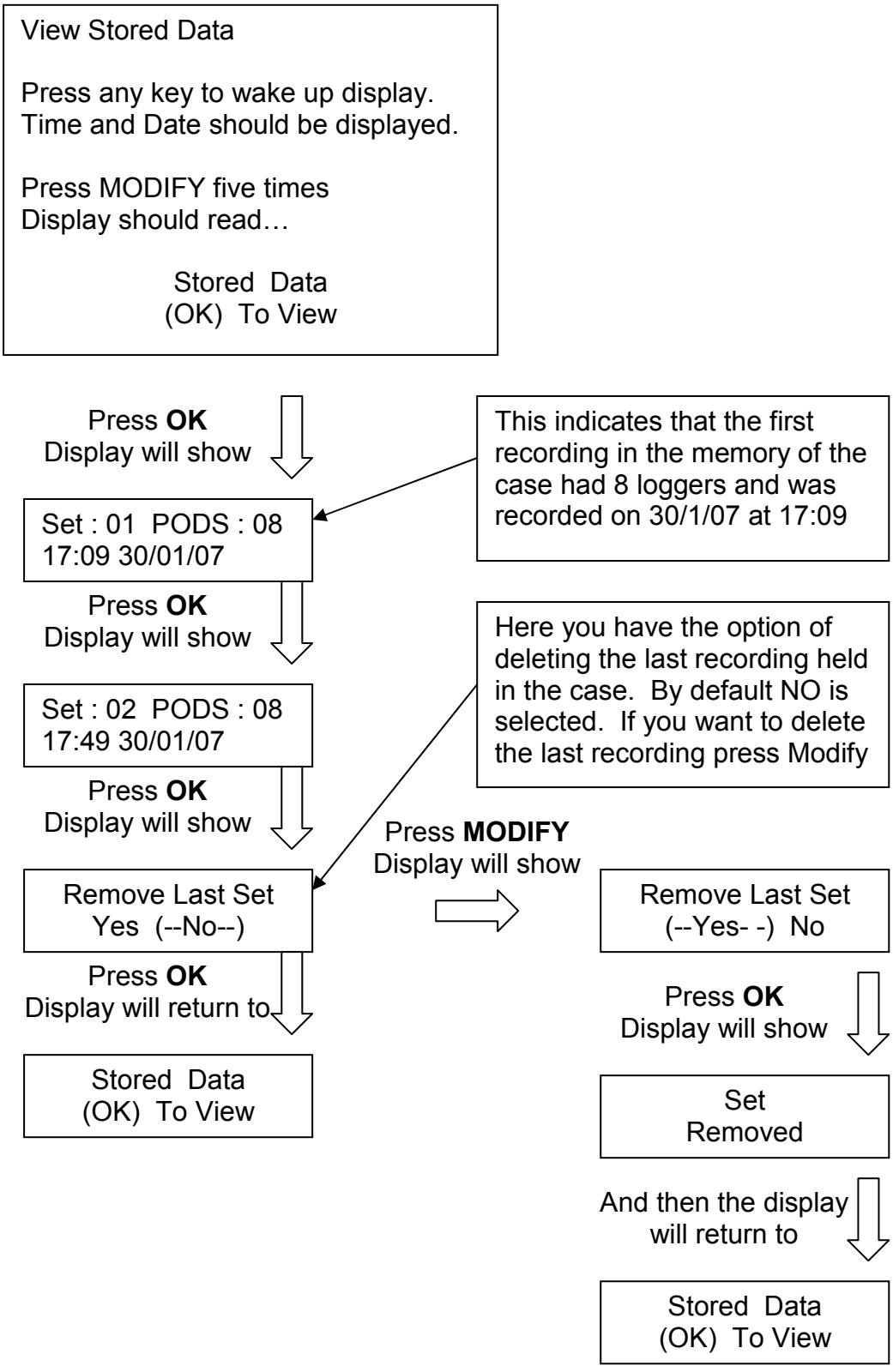
Wake up the display by pressing any key. It should show the current recording session countdown time, or the time and date if recordings have finished.

Download Data From Loggers to Carry Case



When the download data option is used, the data is read from the loggers and held in the memory of the case. It can then be downloaded to the SoundSens software at a later stage.

View Stored Data



Set Time and Data

Set Time and Date

Press any key to wake up display.
Time and Date should be displayed.

Press MODIFY six times
Display should read…

Set Time/Date
(OK) To Start

Time and Date Displayed

Press **OK**

Set Hour

Press **Modify** to change value
Then press **OK**

Set Minutes

Press **Modify** to change value
Then press **OK**

Set Day

Press **Modify** to change value
Then press **OK**

Set Month

Press **Modify** to change value
Then press **OK**

Set Year

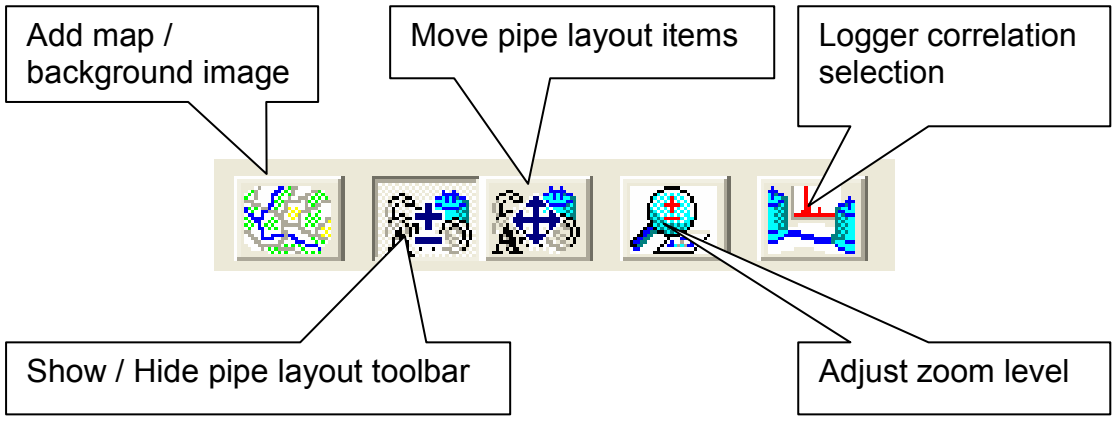
Then press **OK** to set the time.

Dealing With Data

Creating A Pipe Layout

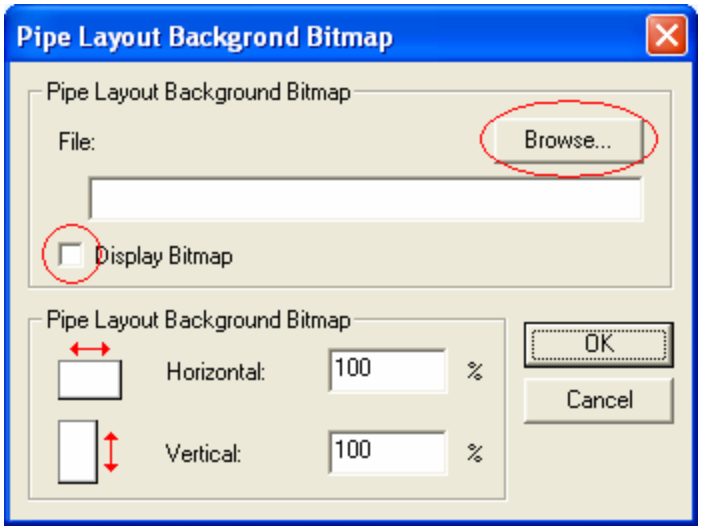
It is possible to either create a basic schematic layout of the underground pipe work, or add a background image for illustration purposes.

Pipe Layout Menu



Add a background image (optional)

Click the Add Map / Background Image button.

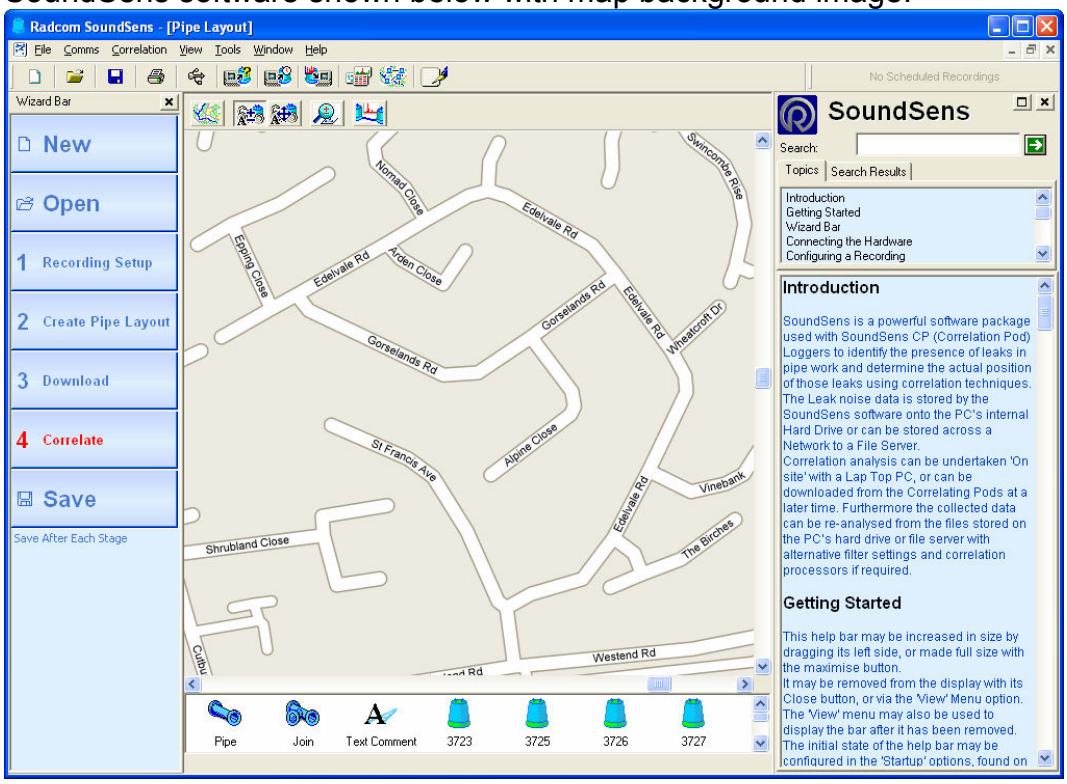


Click Browse and use the standard windows explorer interface to locate a bitmap (bmp) file to use as a background.

You must click the “Display Bitmap” tick box for it to appear on the layout. By default it is **not** ticked.

At a later stage you can go back to this menu and un-tick this option to remove the map.

SoundSens software shown below with map background image.

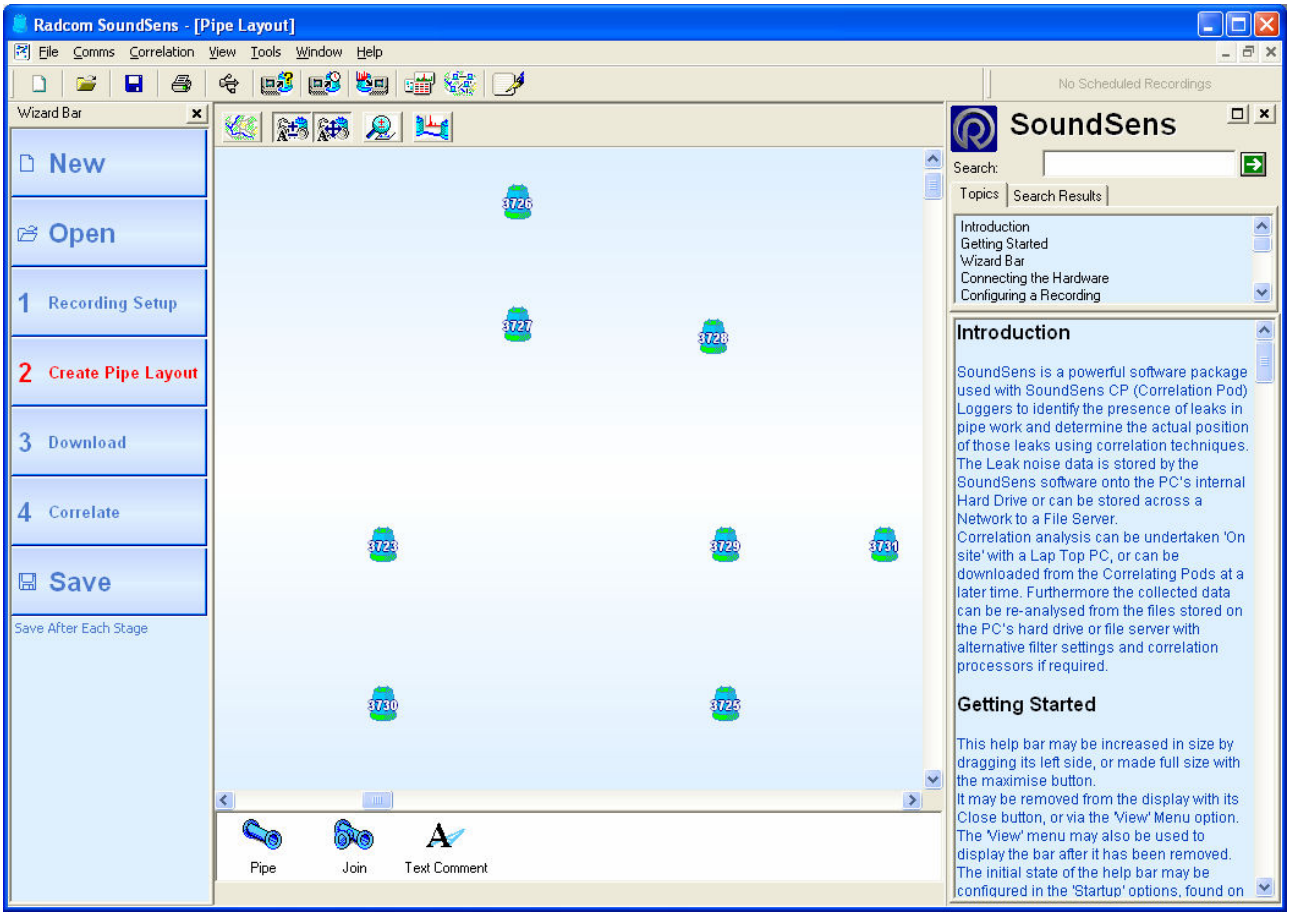


Pipe Layout Toolbar

The pipe layout toolbar at the bottom of the pipe layout area shows Pipe, Join, Text Comment and the serial of each logger used.

Putting loggers on the map

Start by selecting a logger and with the mouse button held down drag and drop it from the toolbar onto the pipe layout area. It is not important to place the loggers precisely as the software pays no attention to position on the screen. The most important data is pipe length and material type which is entered later.



Putting joins on the map

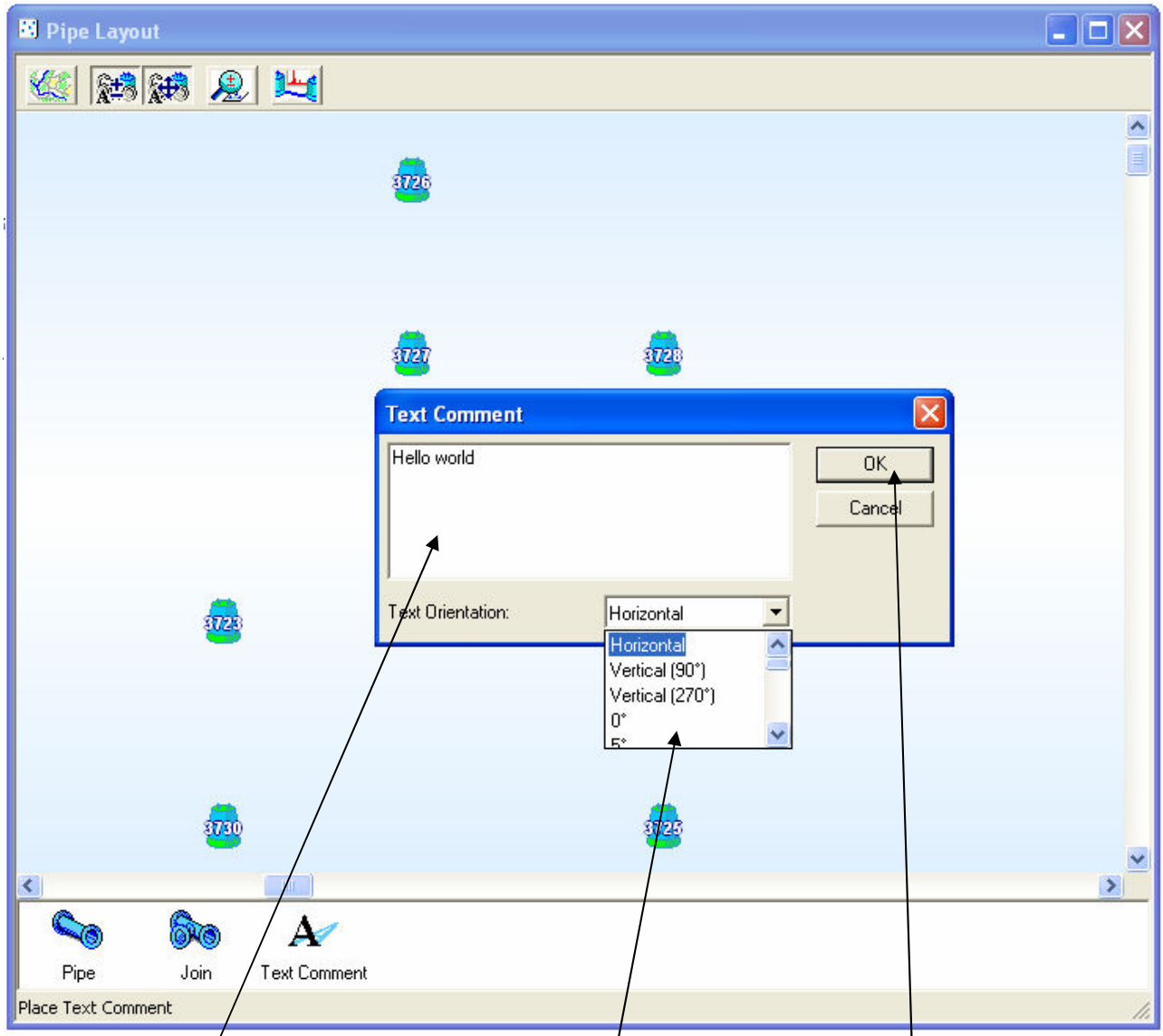
To add a join on the map click once on Join and then click once on each place that you need a join. Only use a join

for a change in pipe direction, or pipe material.

REMEMBER TO SAVE REGULARLY (PAGE 8)

Putting text comments on the map

To add a text comment click Text Comment and then click on the map where you wish to see a text comment.

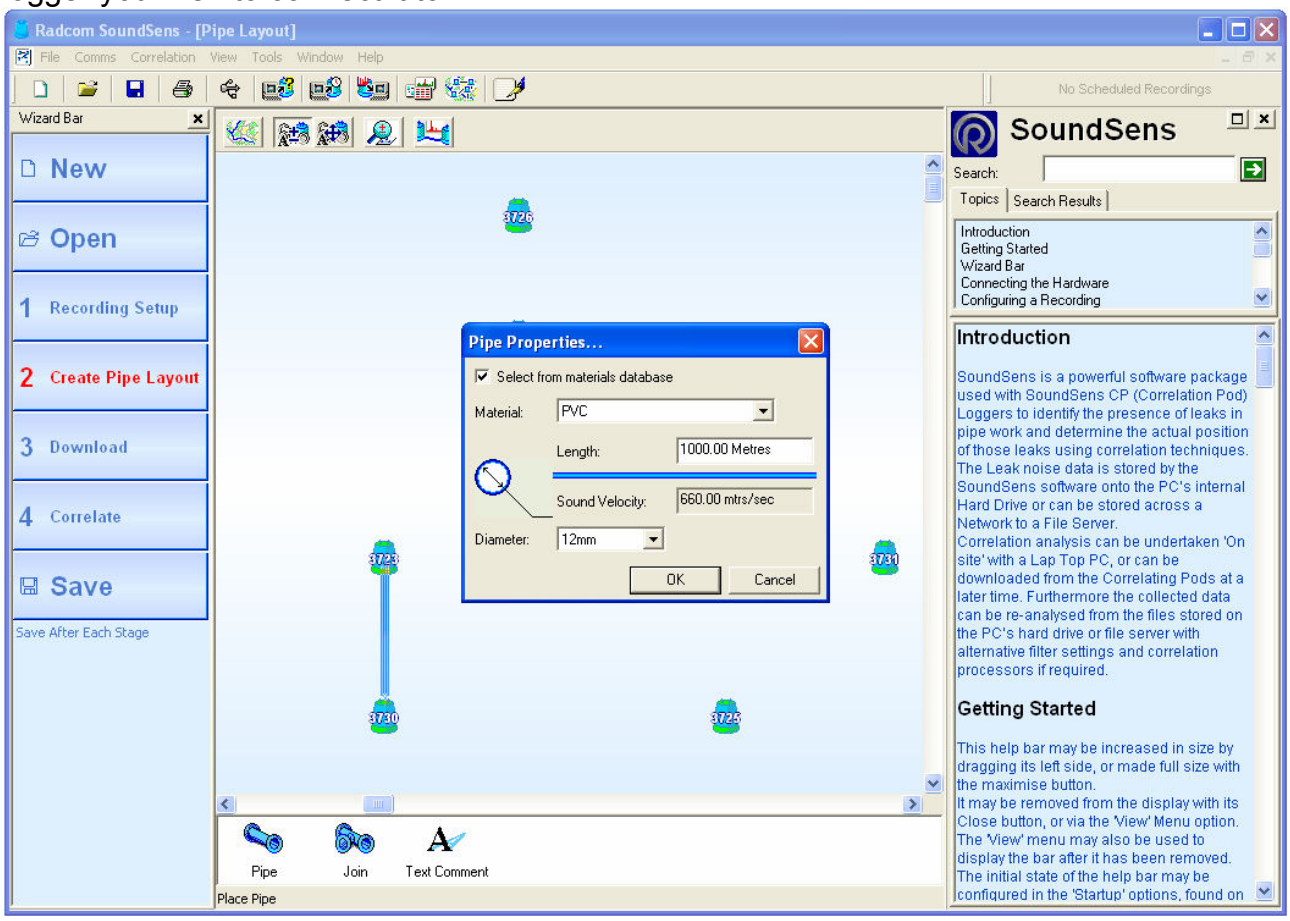


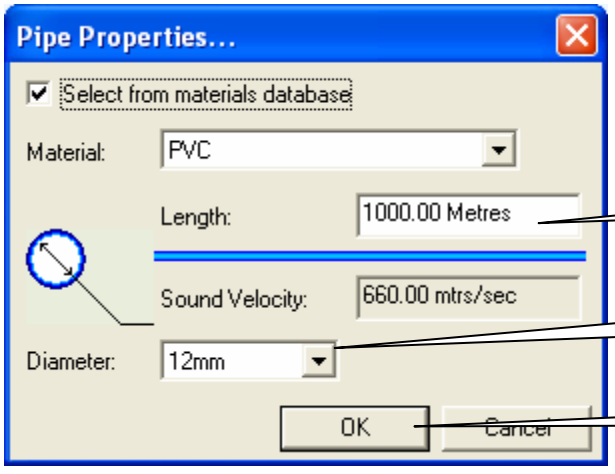
Type your text comment here, and pick a text direction, then click OK

Adding connecting pipe work to the map

After dragging and dropping the loggers onto the pipe layout area and adding the join points you can start adding the connecting pipes.

Click the pipe icon once and then move the mouse pointer over one of the loggers. Click and hold the mouse button down over the first logger and then move the mouse to the logger you wish to connect it to.





Selecting a material from the drop down list will set a sound velocity. Un-tick “Select from materials database” to enter your own sound velocity.

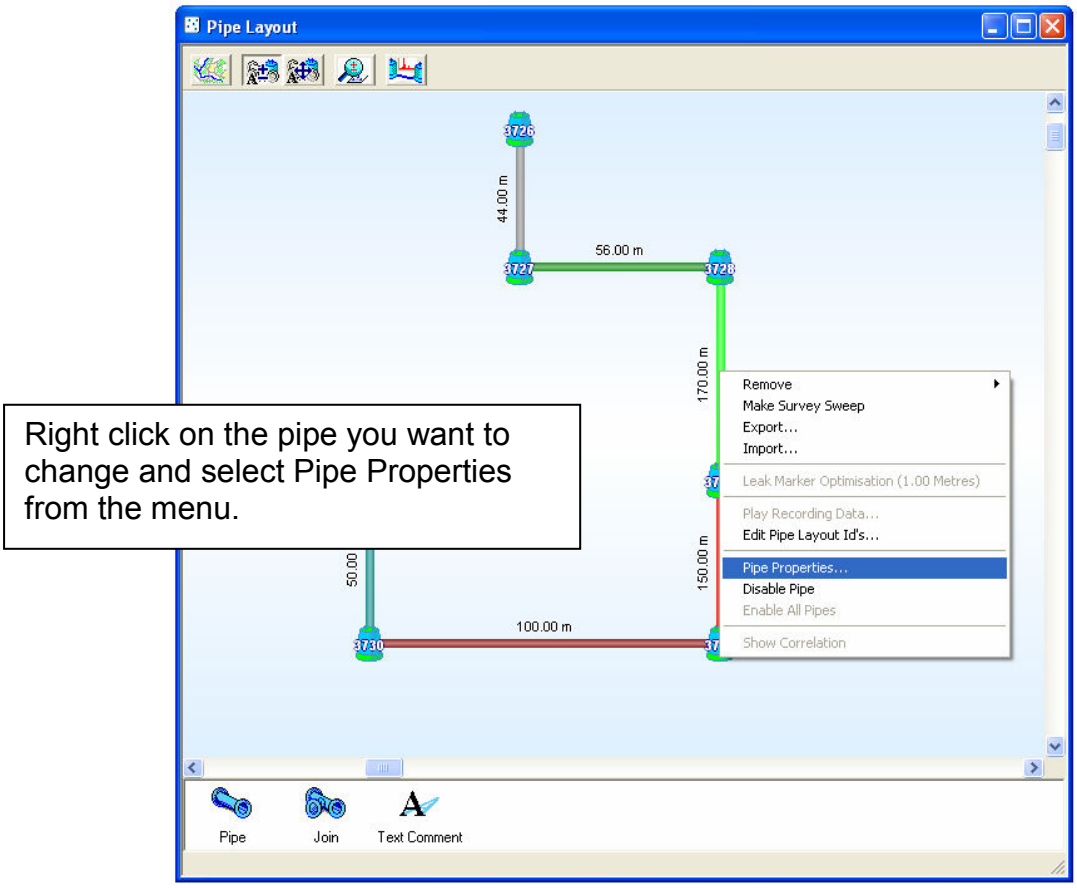
Enter the pipe length

.

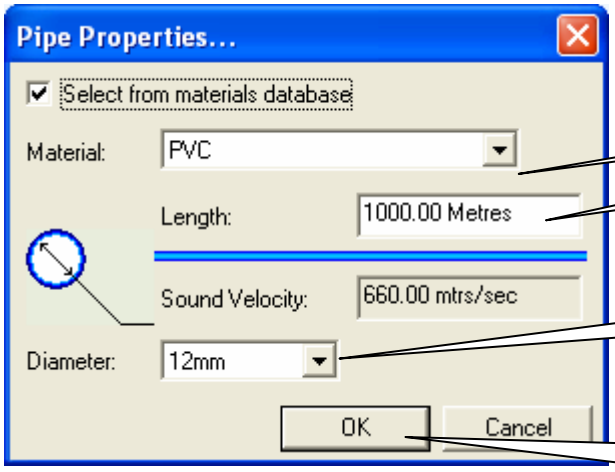
Select the pipe diameter from the drop down menu

Click OK

Changing Properties on Pipe Layout



Right click on the pipe you want to change and select Pipe Properties from the menu.



Change the pipe material here

Change the pipe length here

Change the pipe diameter from the drop down menu here

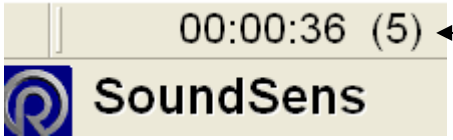
Click OK to keep the changes or Cancel to leave unchanged.

REMEMBER TO SAVE REGULARLY (PAGE 8)

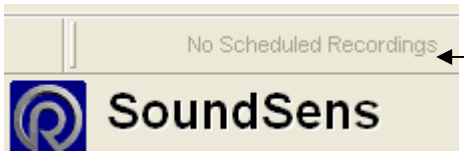
Download loggers

The loggers can be collected when the recordings have finished.

If you leave the SoundSens software running then you will see the following information to help you tell when the recordings are being done, and when they are finished.



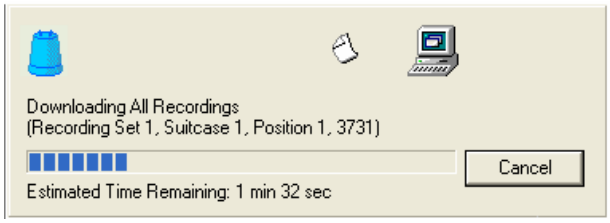
Time shows how long until the recording starts. The number in brackets shows how many recordings are left to do.

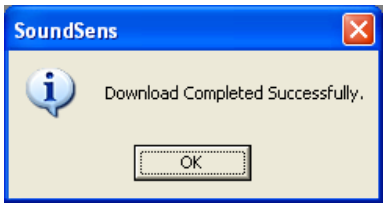


When is says No Scheduled Recordings it means all the recordings have been finished. The SoundSens software must be left running for this to work. If the software is stopped then the counter will reset back to showing No Scheduled Recordings.

Note : When the loggers are put back in the case for downloading they can go back in any order.

With the SoundSens software running and the USB cable connected between the laptop and the suitcase click the Download button.





If any fail to communicate you will see this error message.

Downloading Loggers (Multiple Suitcases)

Connect the suitcases together as shown in the section “Information regarding daisy chaining multiple cases together”

Connect the USB cable to the first suitcase.

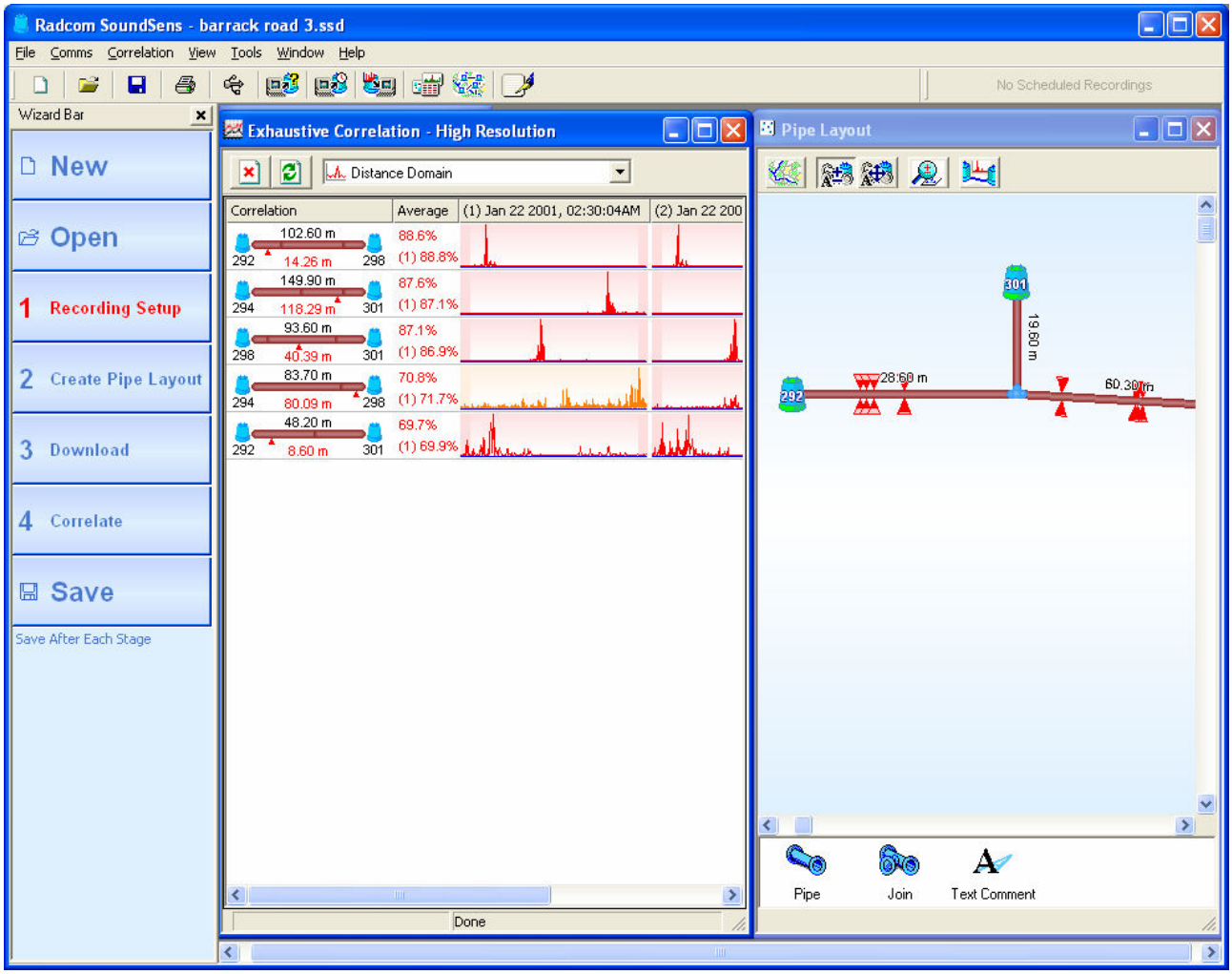
Click the Download button.

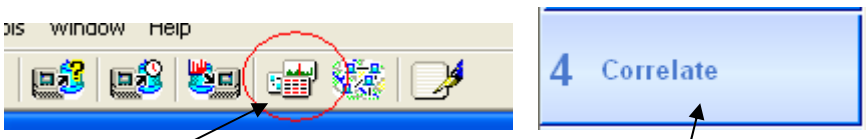
The software will ask for conformation about the number of cases. If this number is incorrect ensure the USB cable is connected to the first suitcase, and that all the cases are connected together correctly.

If the number of cases is correct then the download can begin. After each box of loggers has been downloaded the software will ask for the USB cable to be moved to the next box in the line. This process will be repeated until all the connected boxes have been downloaded.

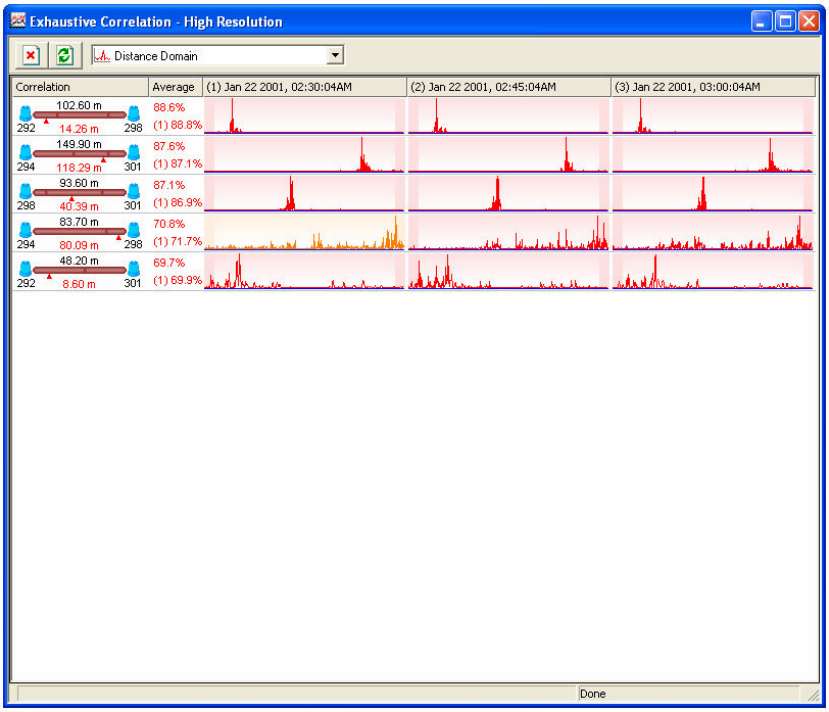
Correlation

After the data has been downloaded correlation begins automatically.

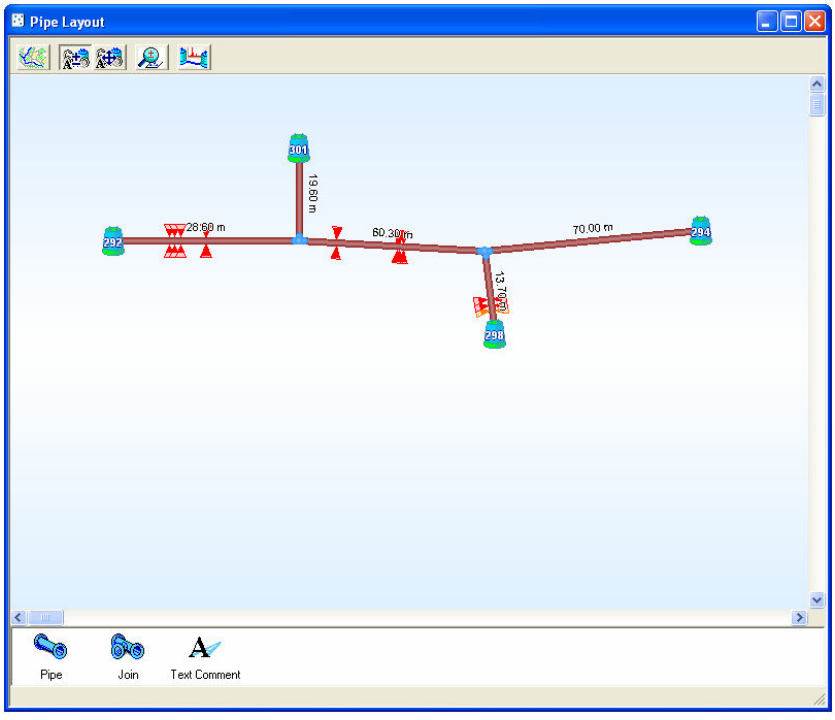




To begin the correlation process manually after opening a data file click the Perform Correlation button, or click Correlate on the left menu bar.

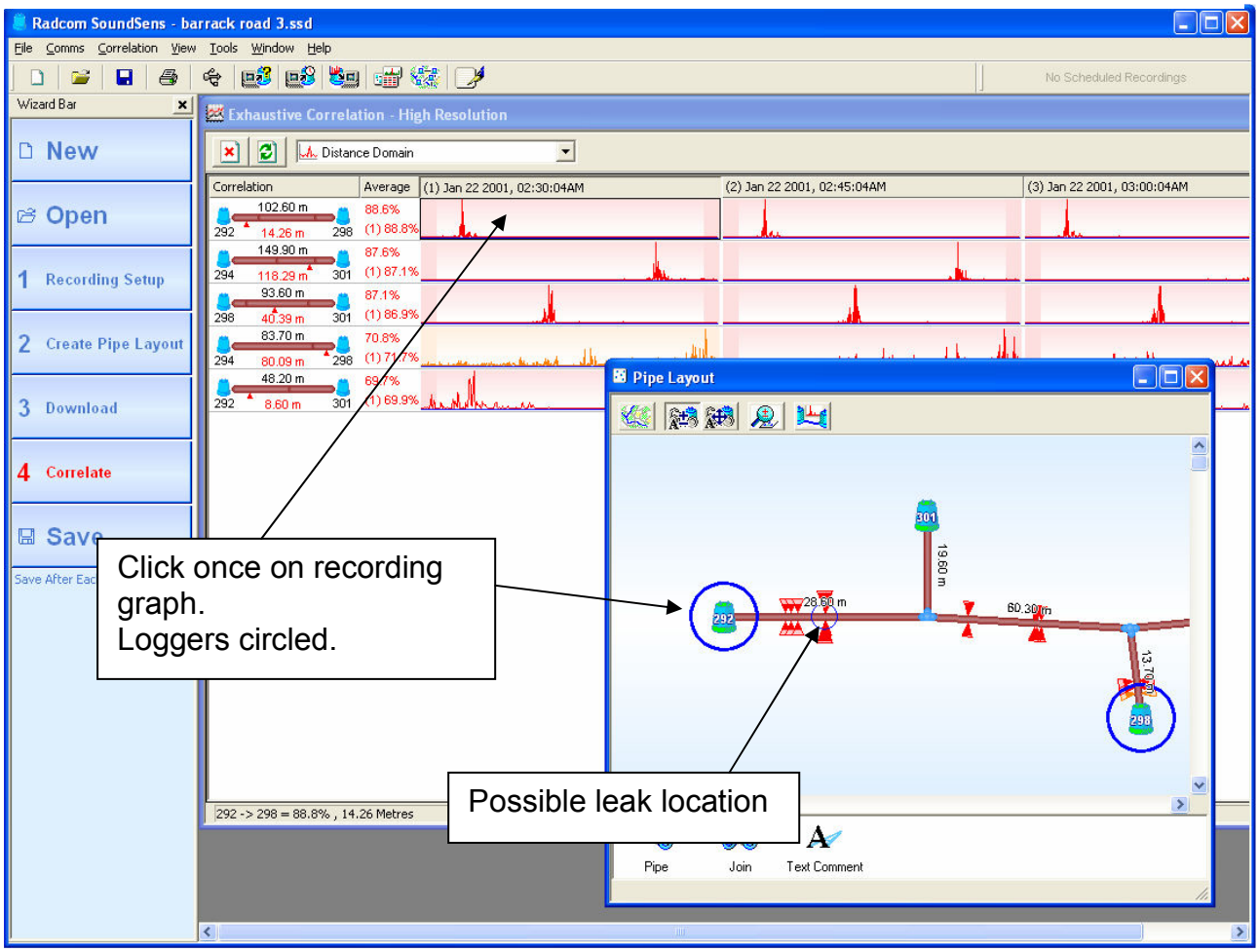


After correlation has finished the software sorts the data. The most likely leak correlations will be at the top.

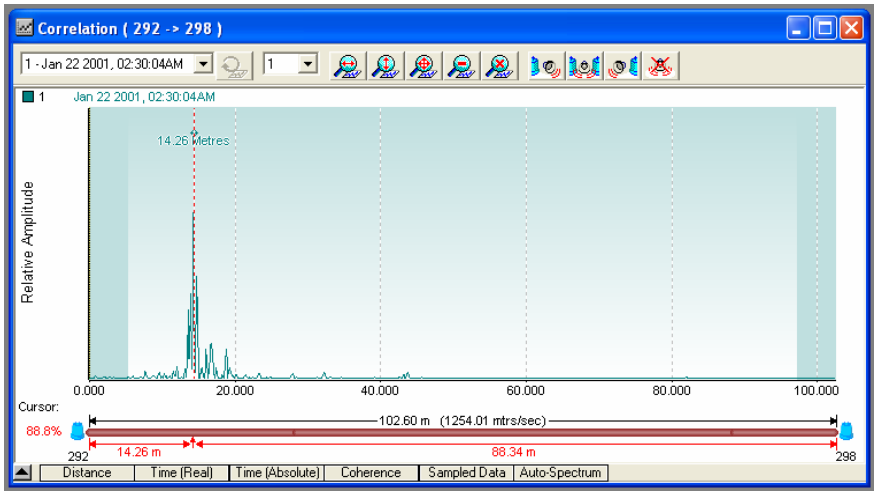


The location of each possible leak is marked on the map by red markers.

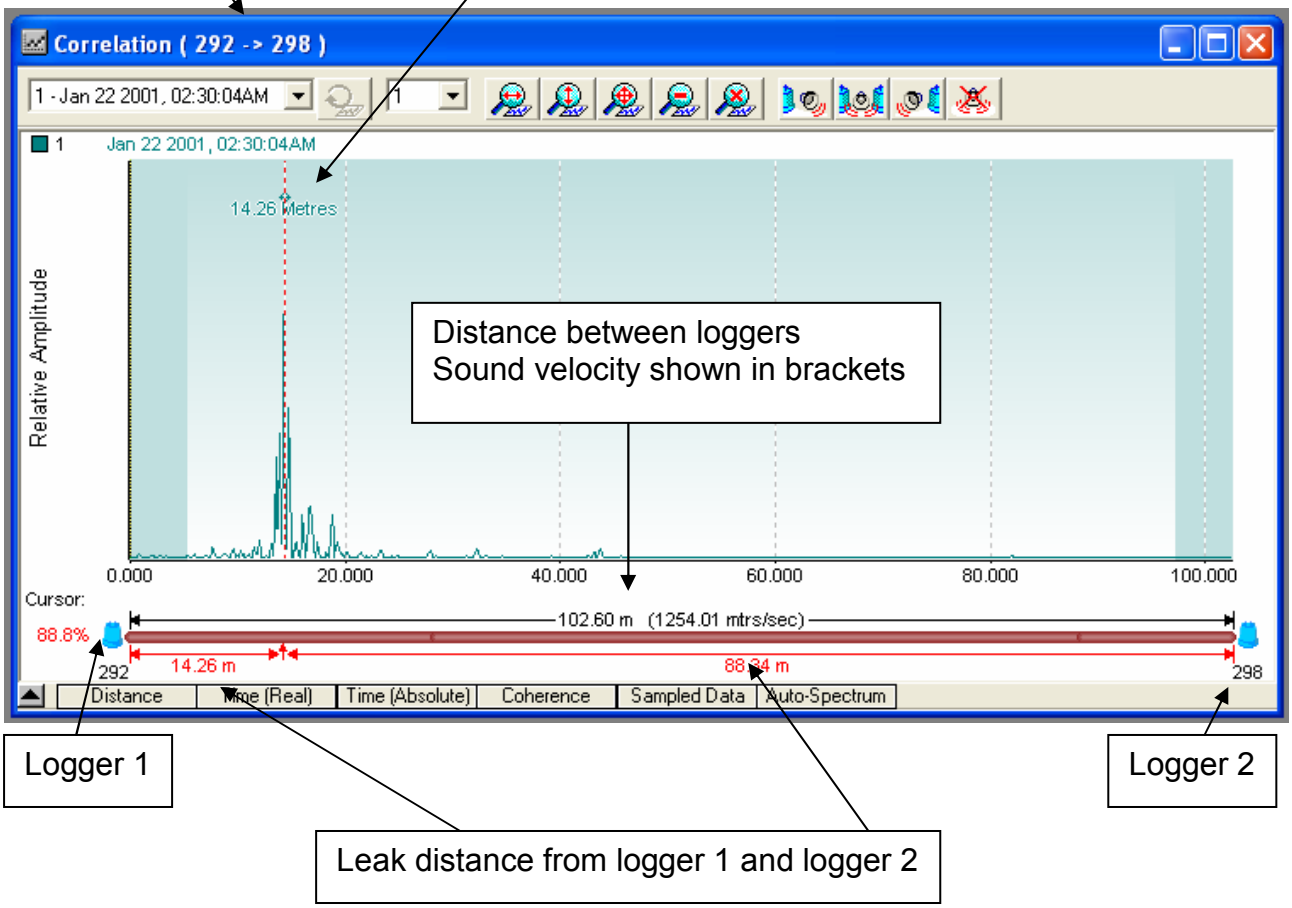
Click once on the recording graph and the blue circles will indicate which two loggers have been correlated between.
A third smaller blue circle will show the possible leak location



Double click on the recording graph to see a close up view.

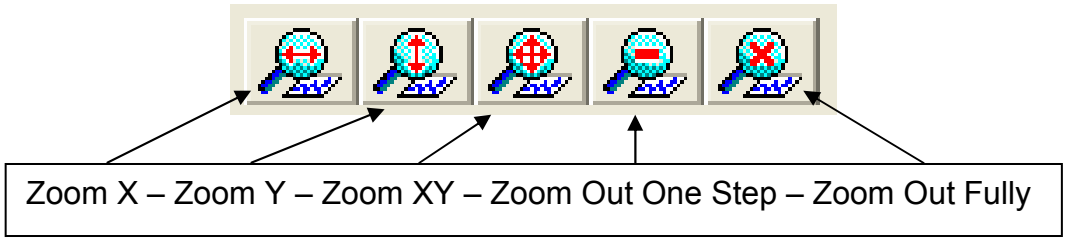


The Basic Recording Graph

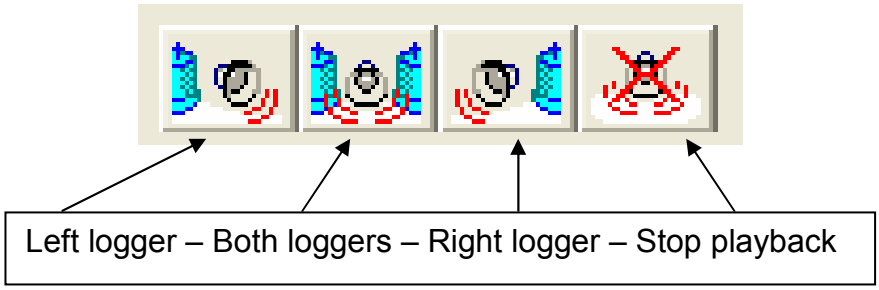


Recording Graph Advance Features

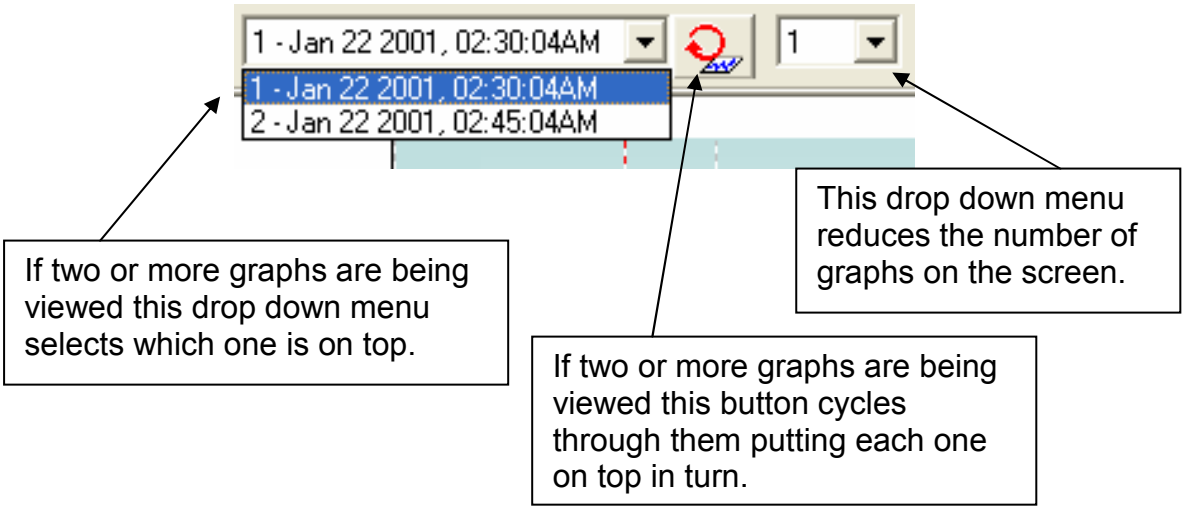
Zoom functions



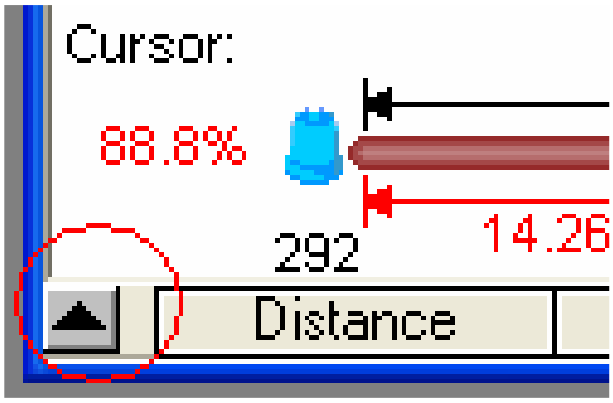
Listen to recordings from loggers



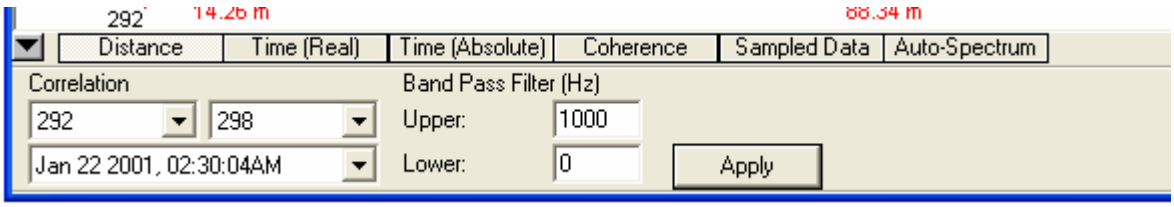
Graph viewing options

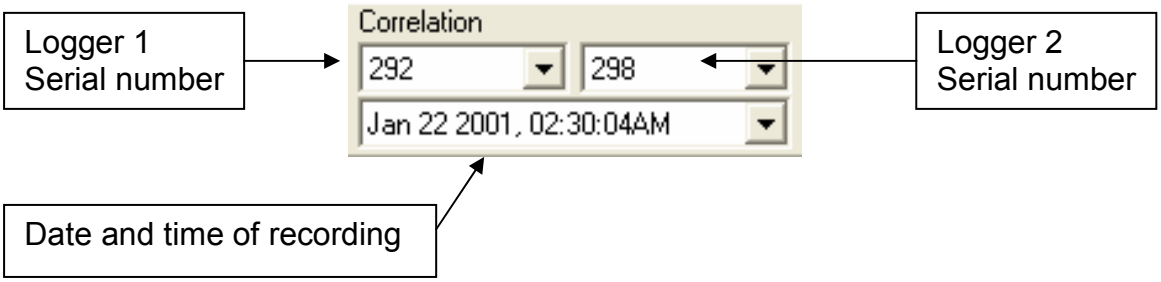


Reveal Advanced Graph Options



Click the small up arrow on the bottom left of the graph to reveal the advance graph options (see below)



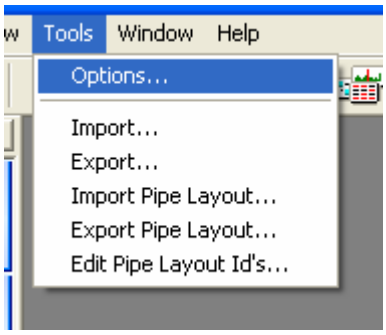


To see the correlation graph between two different loggers just change the serial numbers shown in the drop down menus for logger 1 and logger 2, and then click Apply.

To superimpose another recording taken between the same two loggers over the existing graph, select it from the time and date drop down menu and then click Apply.

To change the Band Pass Filter, adjust the figures and then click Apply.

SoundSens Software Advanced Configuration

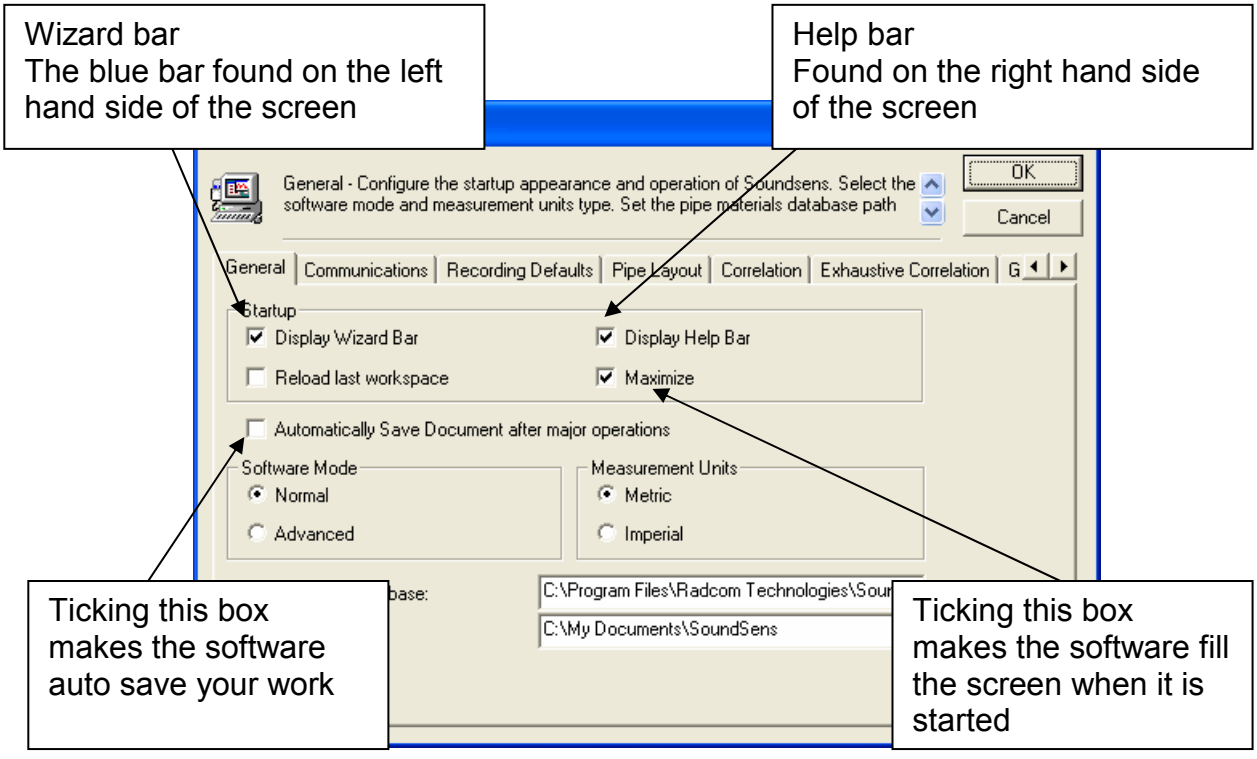


From the Tools menu click Options.

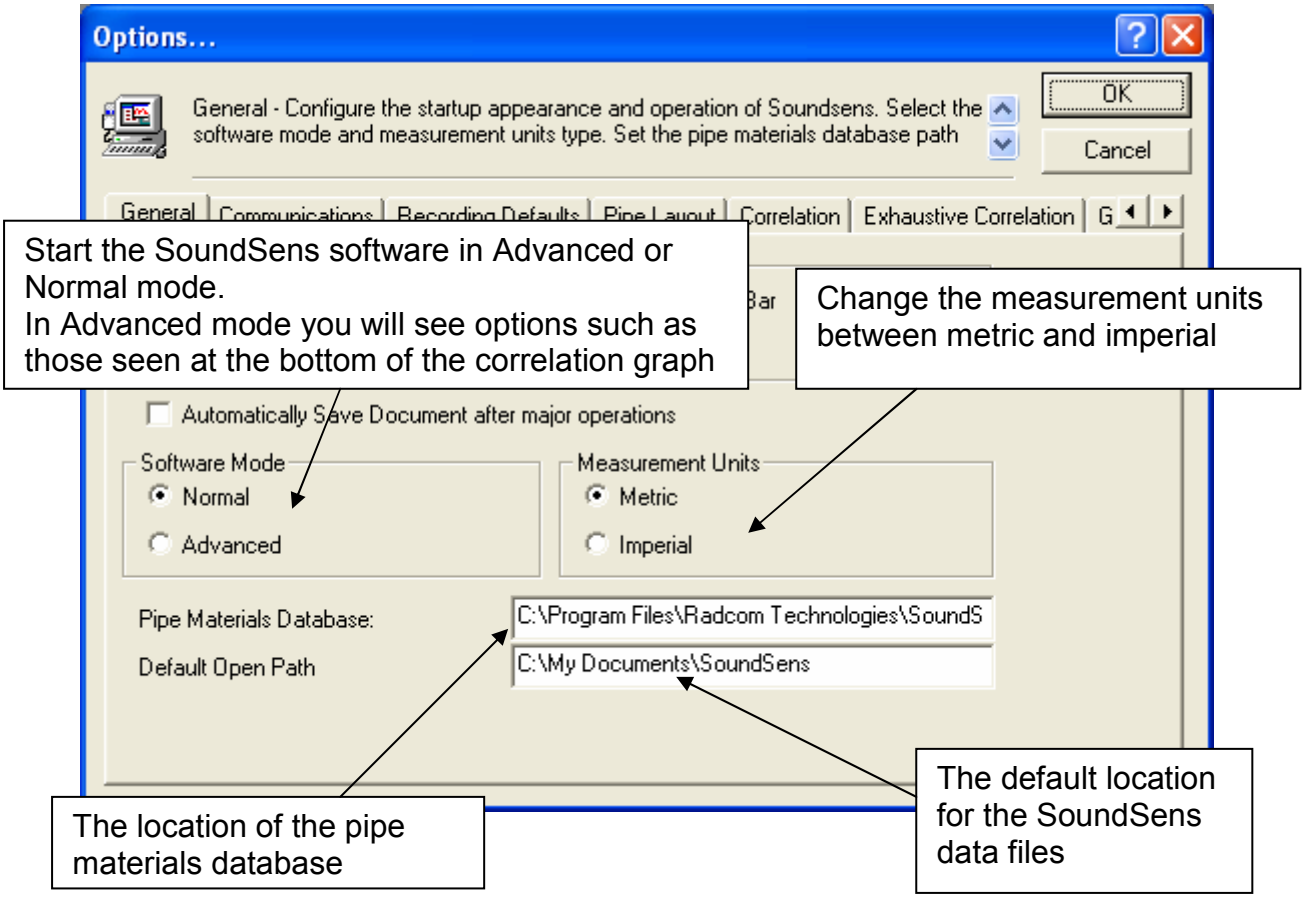
This is intended as a general guide to the SoundSens software options. For further assistance and explanation please contact the Radcom technical support team.

The General tab

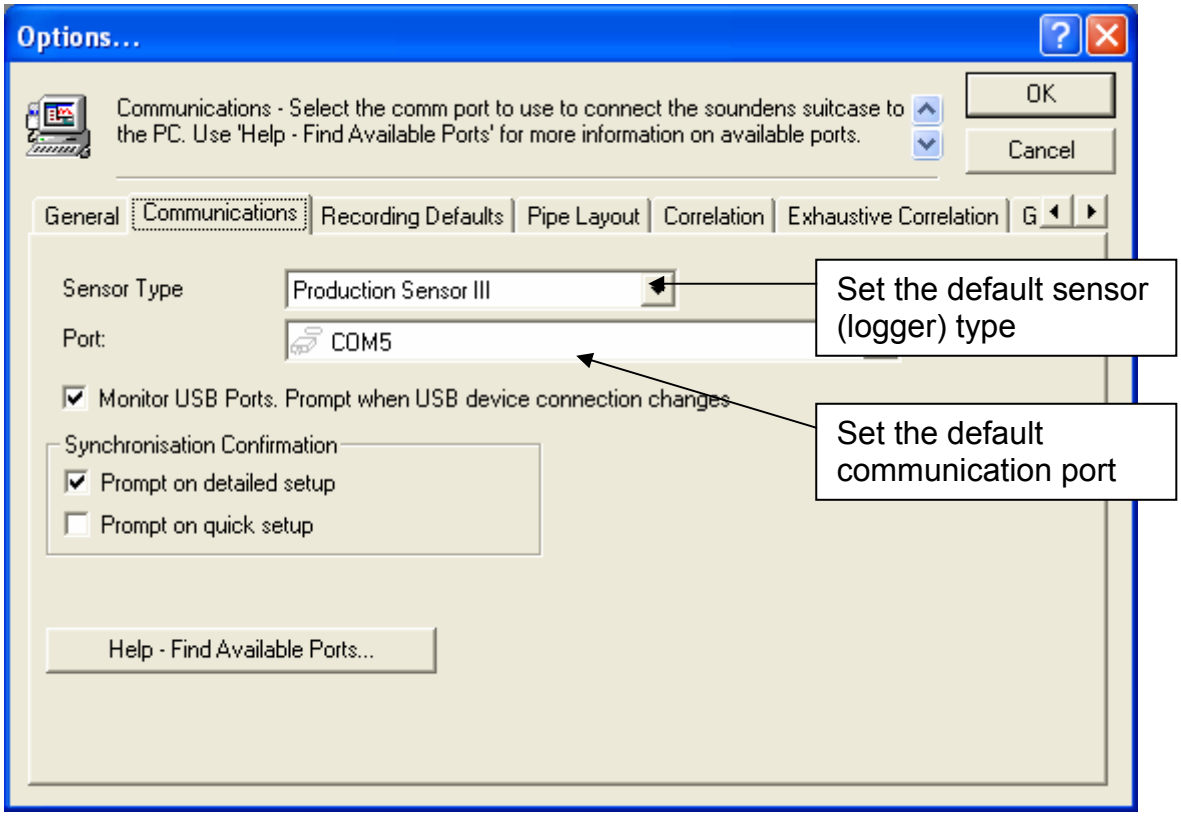
Software start up options.
These changes will take effect next time the software is started.



The General tab (continued)



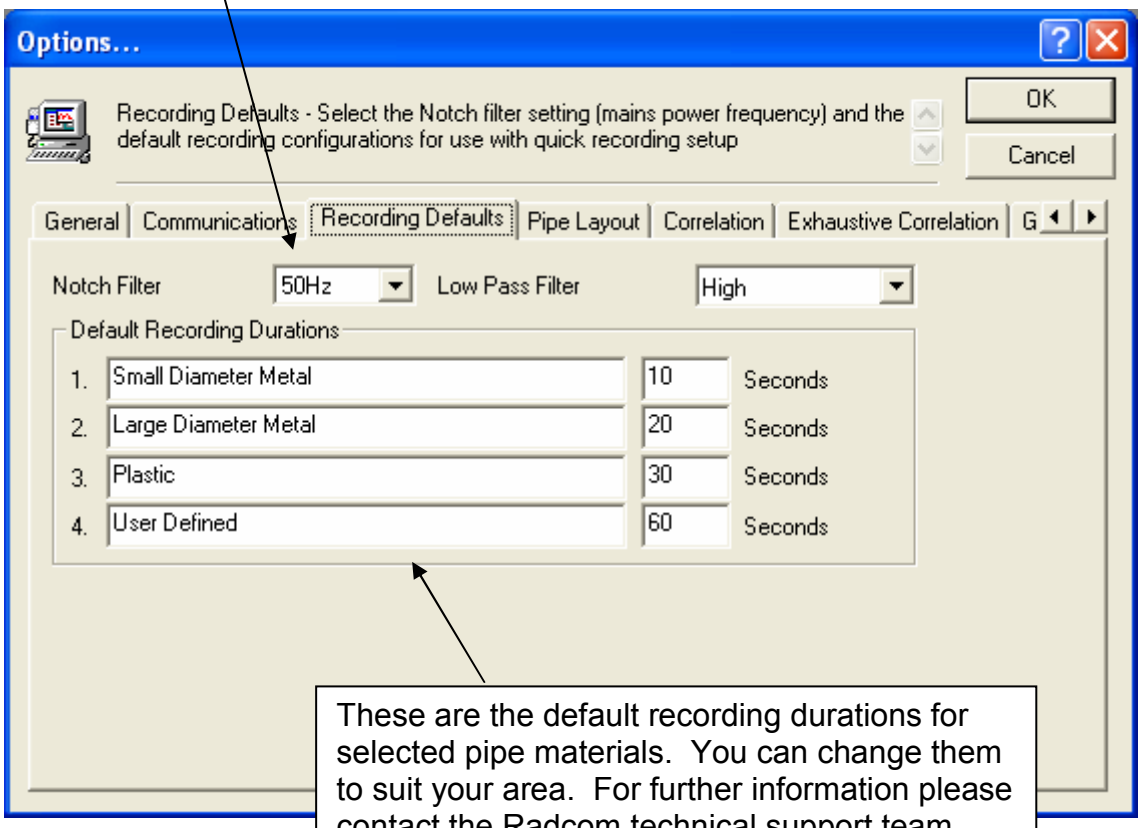
The Communications tab



The Recording Defaults tab

The default recording options.

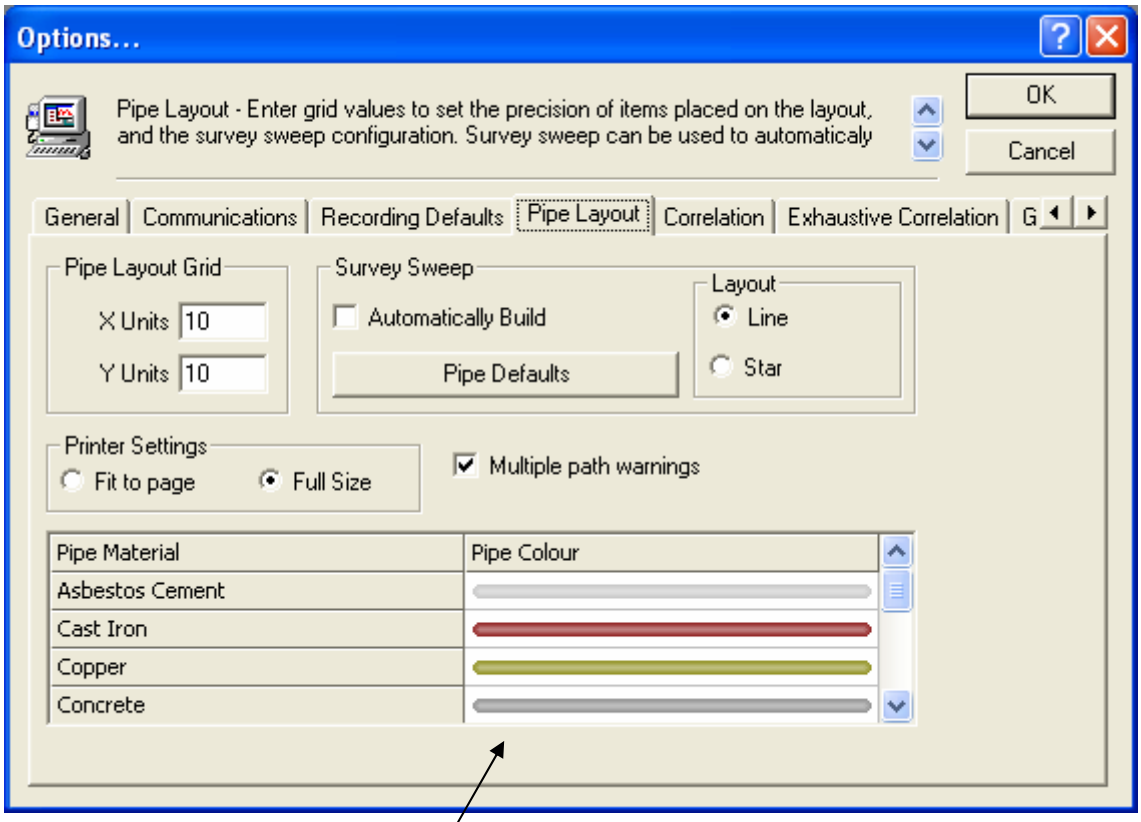
Change the Notch filter value for filtering out mains frequency interference. This is set when the software is installed, but can be changed here (for UK it should be set to 50Hz)



These are the default recording durations for selected pipe materials. You can change them to suit your area. For further information please contact the Radcom technical support team.

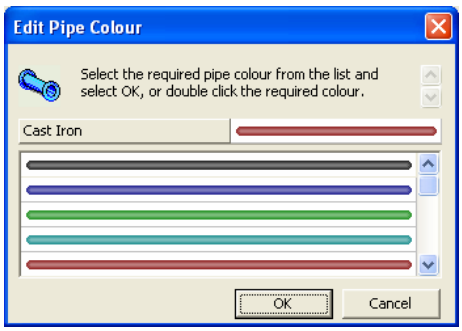
The Pipe Layout tab

The pipe layout area options



To change the colour of the pipes on the pipe layout double click on the coloured area.

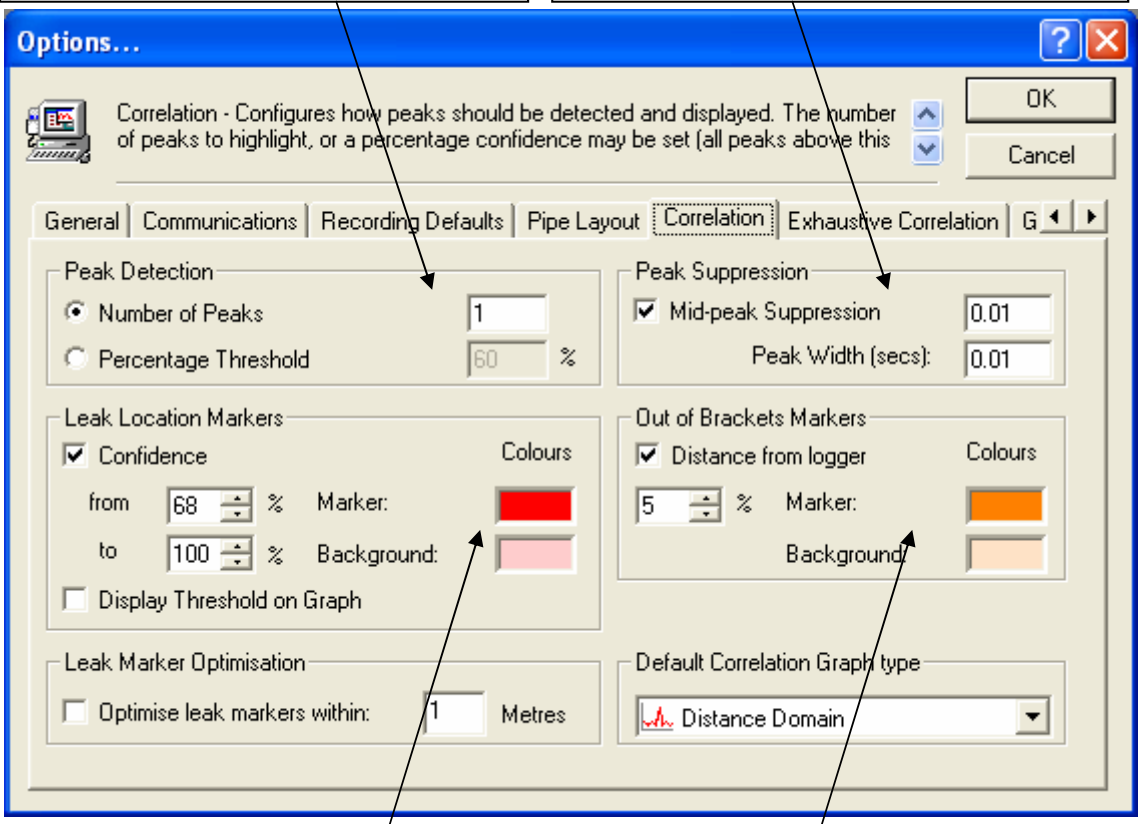
Select a new colour from the menu which pops up on the screen, and then click OK



The Correlation tab

By default only one peak will be highlighted with it's value displayed on the graph. You can change this to a higher number if preferred.

Mid peak suppression
If the logger hears nothing then it may put a large peak in the centre of the correlation graph. This option will prevent it from happening

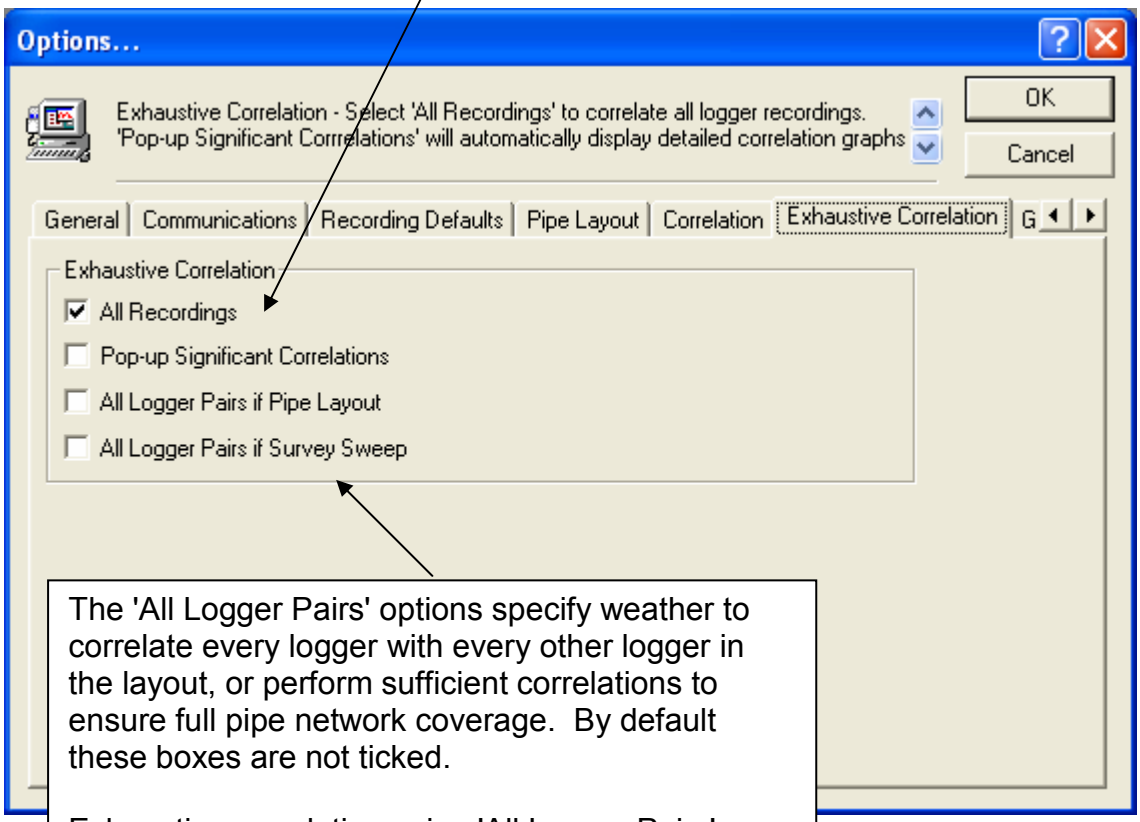


Change the default colours of your leak location and out of bracket markers here.

The Exhaustive Correlation tab

The default option here is All Recordings. This will perform correlation using all the recordings in the loggers.

Use Pop-up Significant Correlations to automatically display the graph or graphs for locations most likely to have leaks.

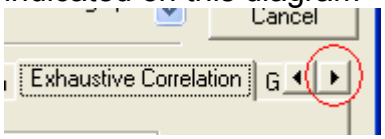


The 'All Logger Pairs' options specify weather to correlate every logger with every other logger in the layout, or perform sufficient correlations to ensure full pipe network coverage. By default these boxes are not ticked.

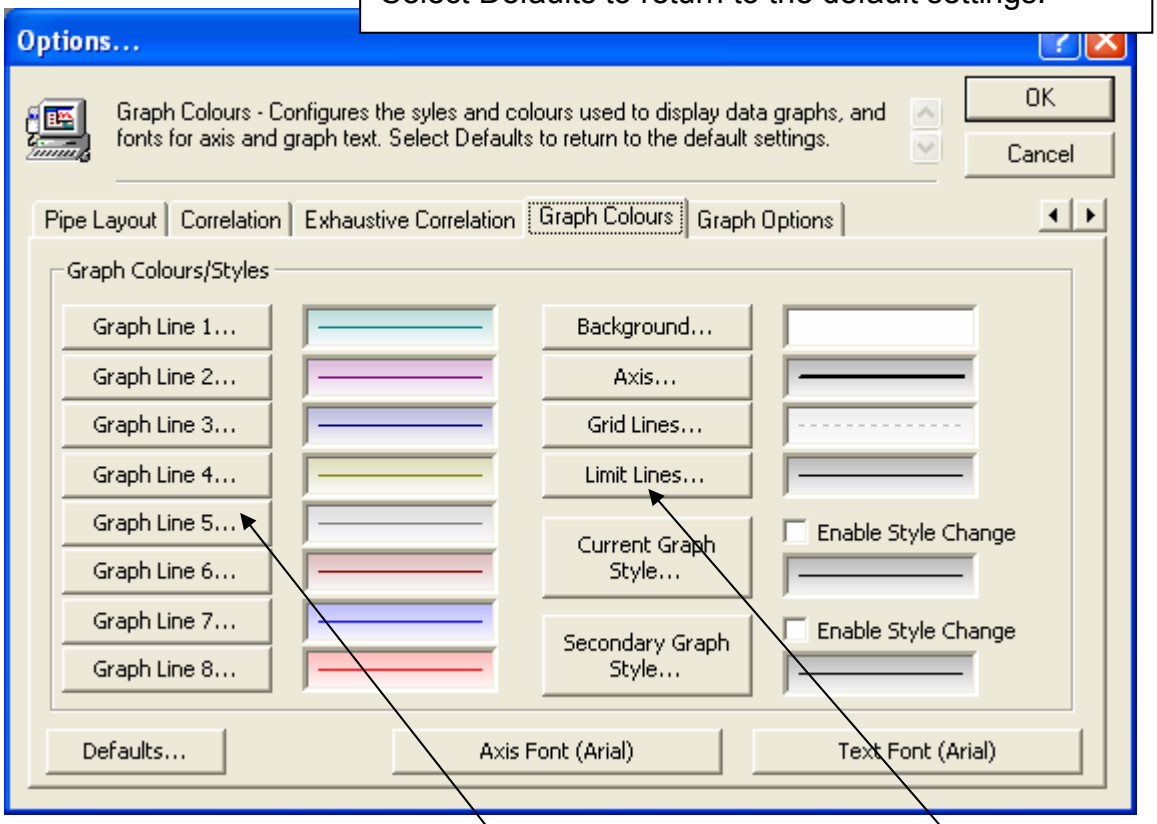
Exhaustive correlation using 'All Logger Pairs' may take significantly longer on a large pipe network.

The Graph Colours tab

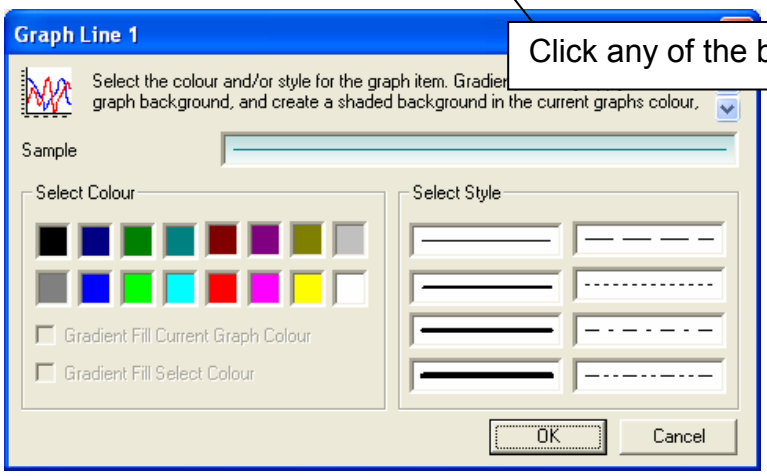
To access the tabs past Exhaustive Correlation you need to click the right hand arrow as indicated on this diagram



Configures the styles and colours used to display data graphs as well as fonts for axis and graph text. Select Defaults to return to the default settings.



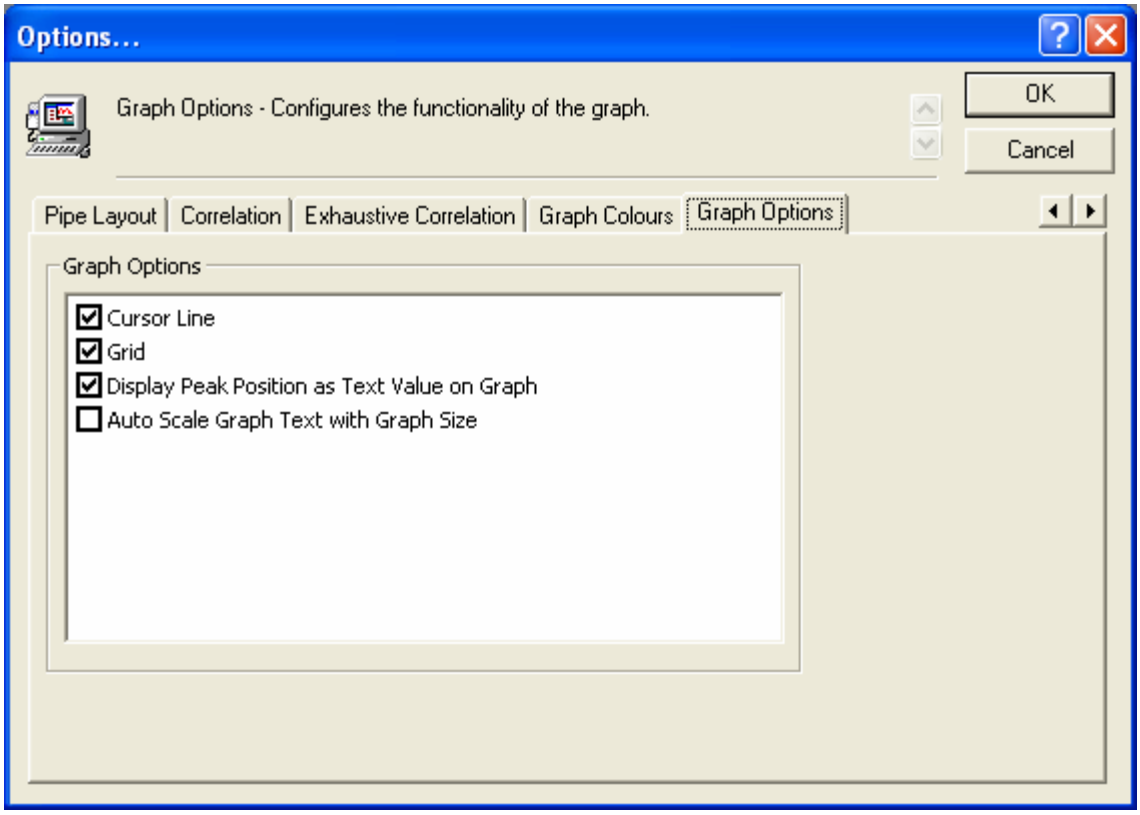
Click any of the buttons to change a colour



Select a new line colour and style, and then click OK

The Graph Options tab

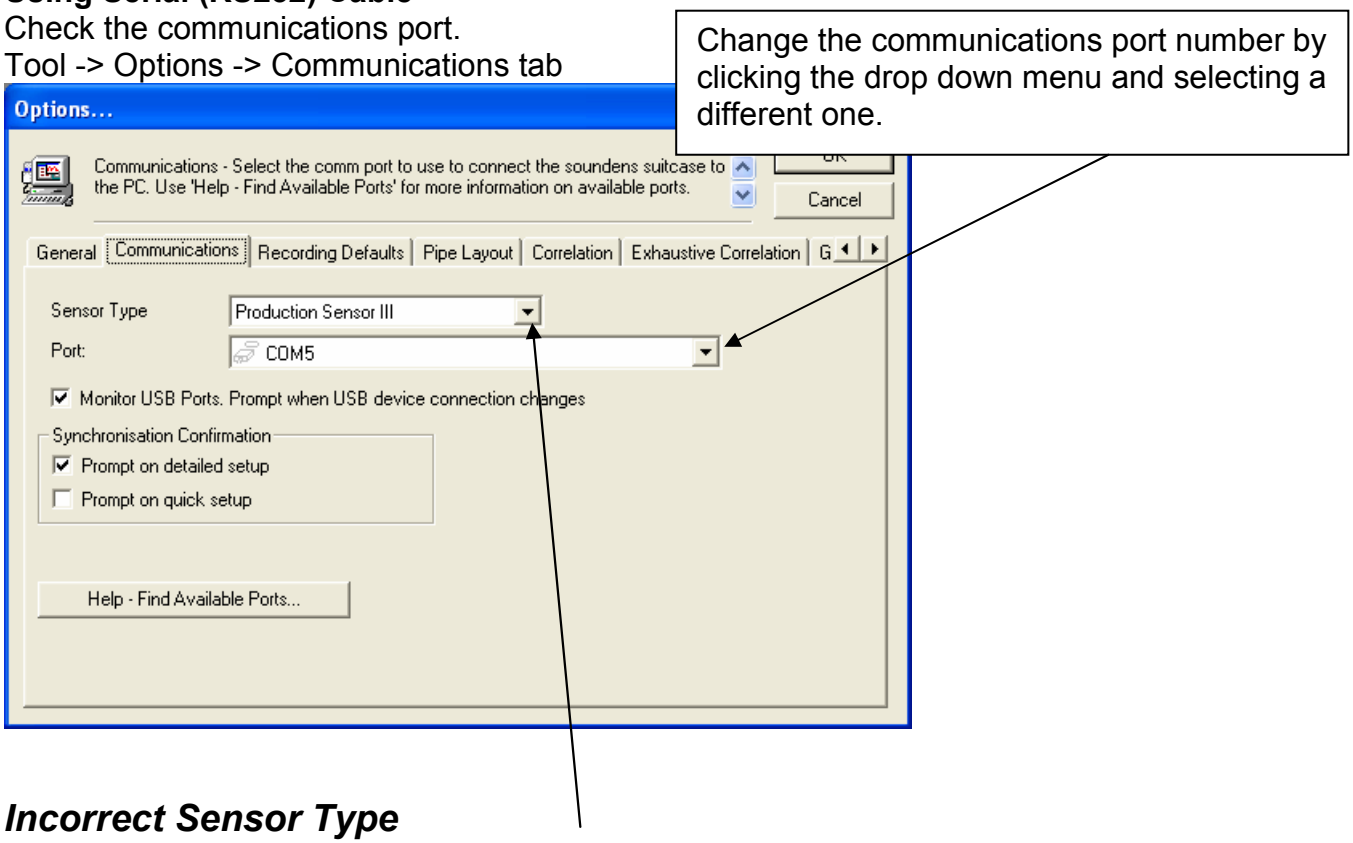
Configures the functionality of the graph.



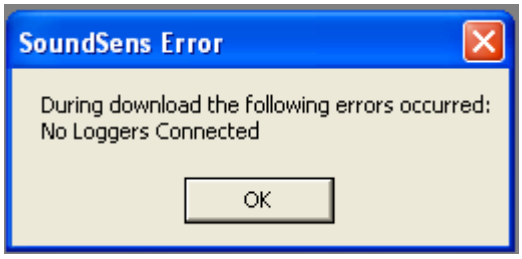
Troubleshooting

Carry Case Not Communicating with PC or Laptop

Using Serial (RS232) Cable
Check the communications port.
Tool -> Options -> Communications tab



Incorrect Sensor Type



If the wrong sensor type is selected you may see an error during communication.

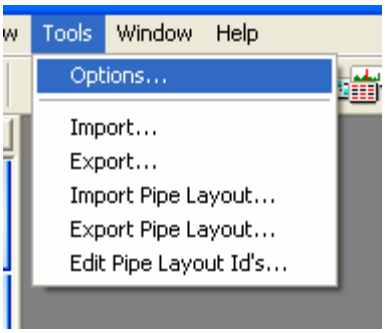
Change the sensor type from the drop down menu

The options are

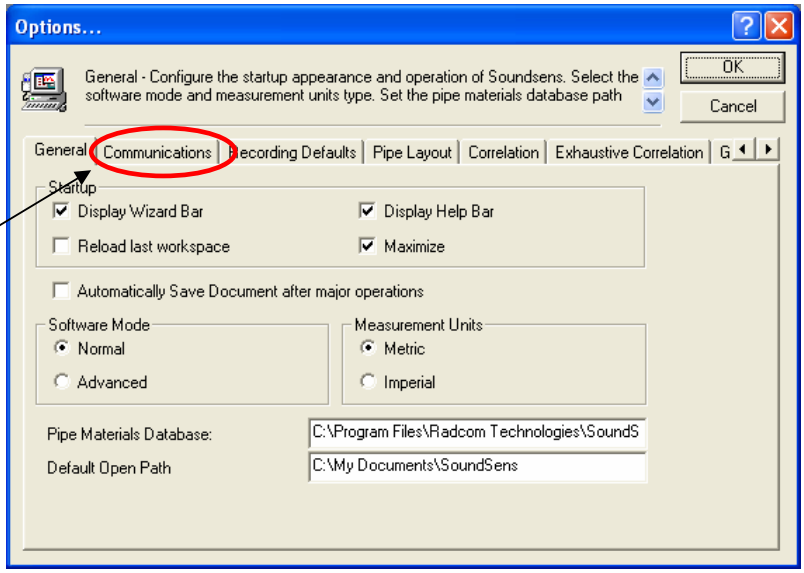
- Pre Production Sensor
- Production Sensor (The original SoundSens logger)
- Production Sensor II (Dark blue plastic logger)
- Production Sensor III (Otherwise known as SoundSens i)

Change Sensor Type

From the Tools menu click Options

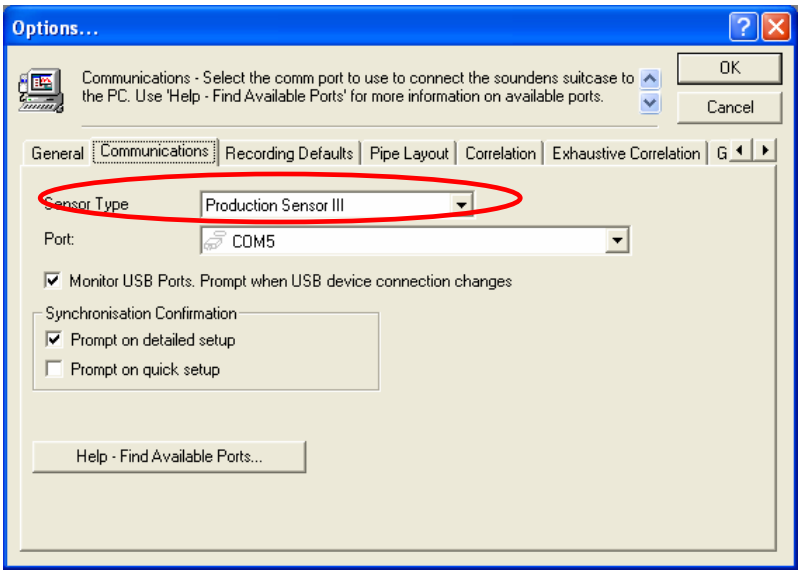


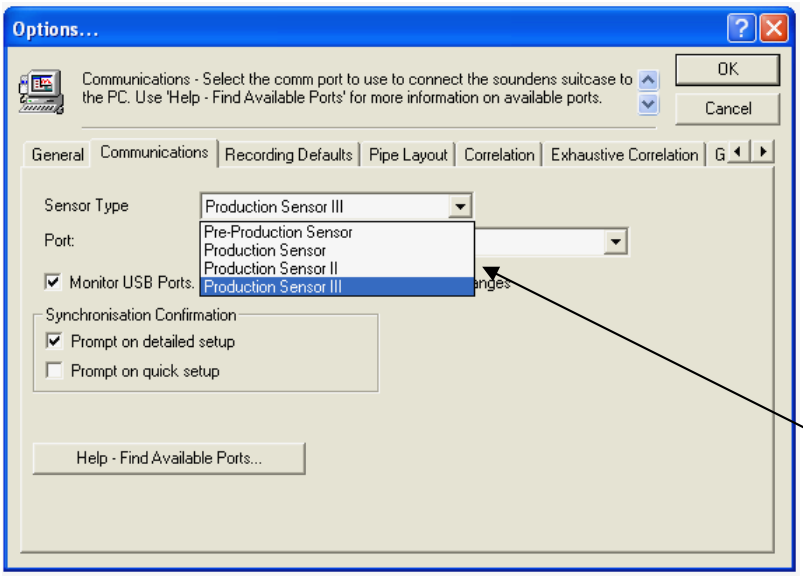
Click the Communications tab



The currently selected sensor Is shown here

To change the sensor type follow the next instruction

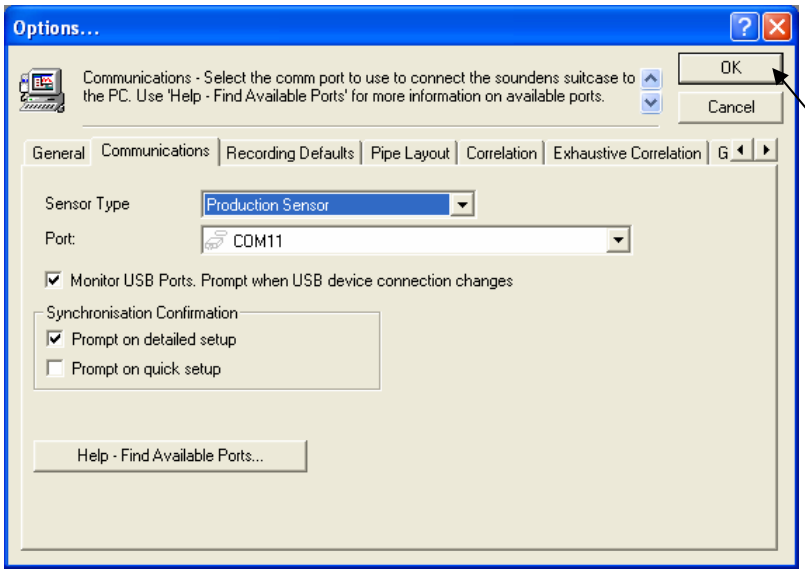




Click the drop down menu and click on the type of sensor you have.

The options are

- Pre Production Sensor
- Production Sensor (The original SoundSens logger)
- Production Sensor II (Dark blue plastic logger)
- Production Sensor III (Otherwise known as SoundSens i)



After making your selection click OK to save the change.

SoundSens Software

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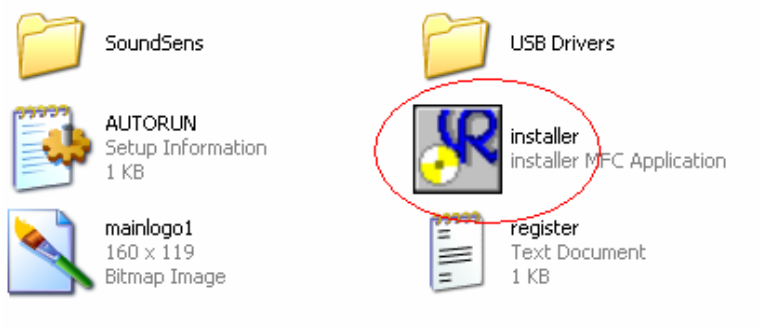
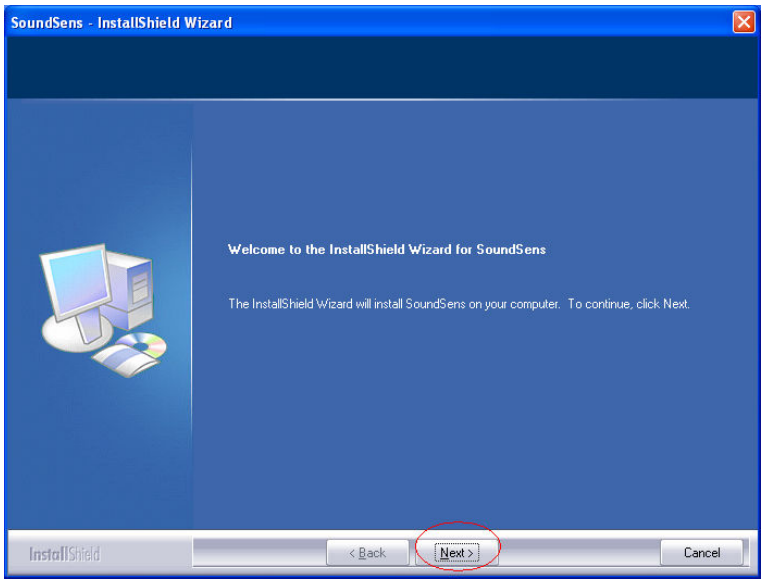
Hampshire SO51 0HR
Tel: +44 (0)1794 528 700 ● Fax: +44 (0)1794 528 760

Installation Instructions

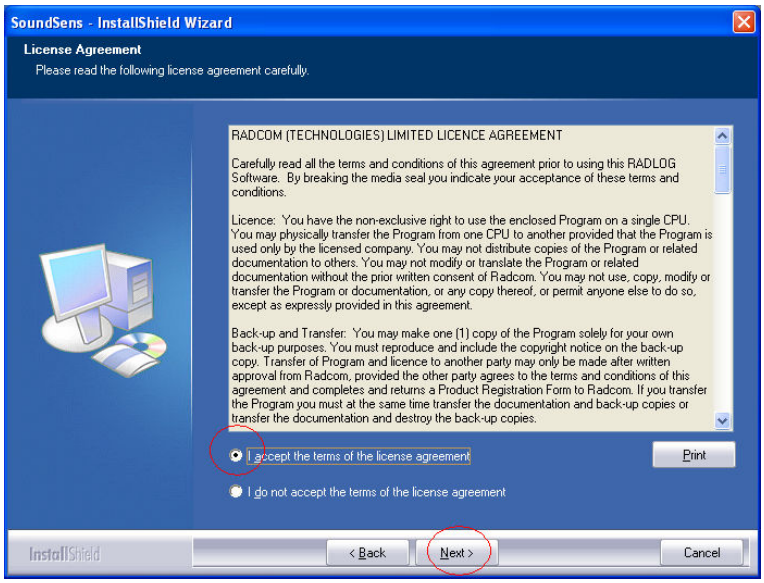


Put the CD in your PC drive, and double click the “installer” icon

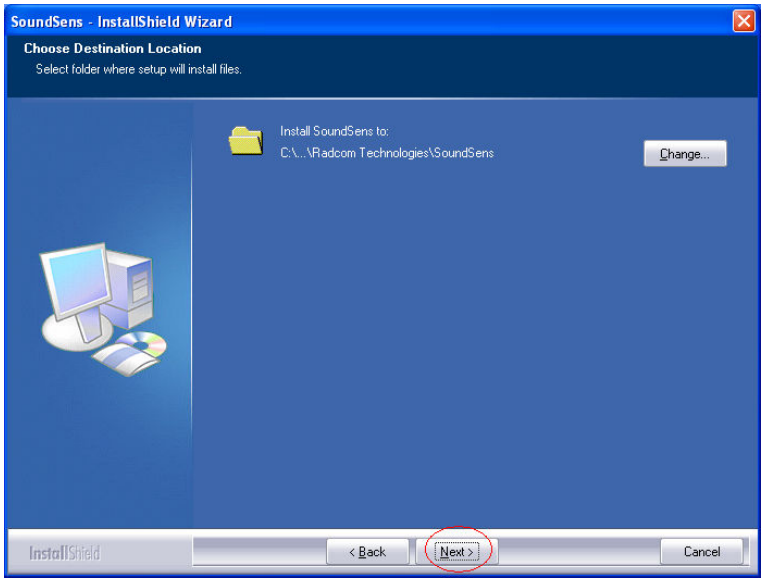
The Radcom Software Installer window will pop up. Click the SoundSens button.



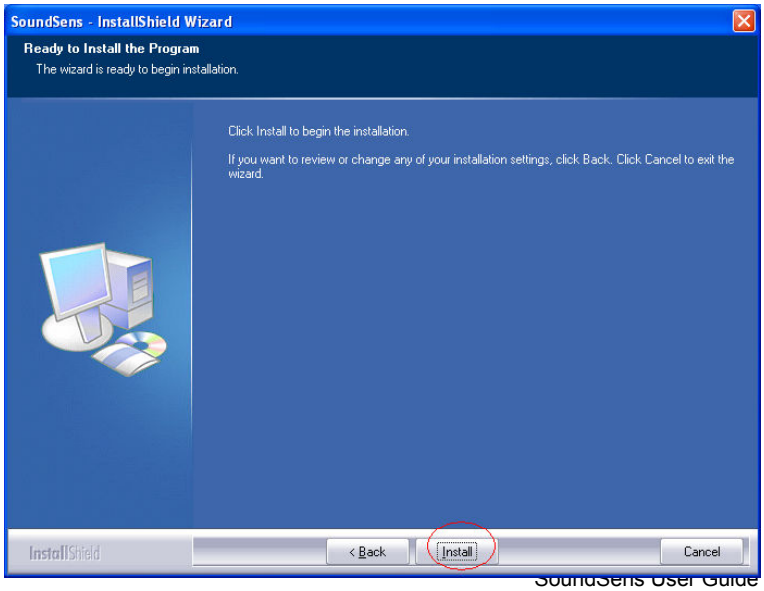
When the Installation Wizard begins click Next to continue.



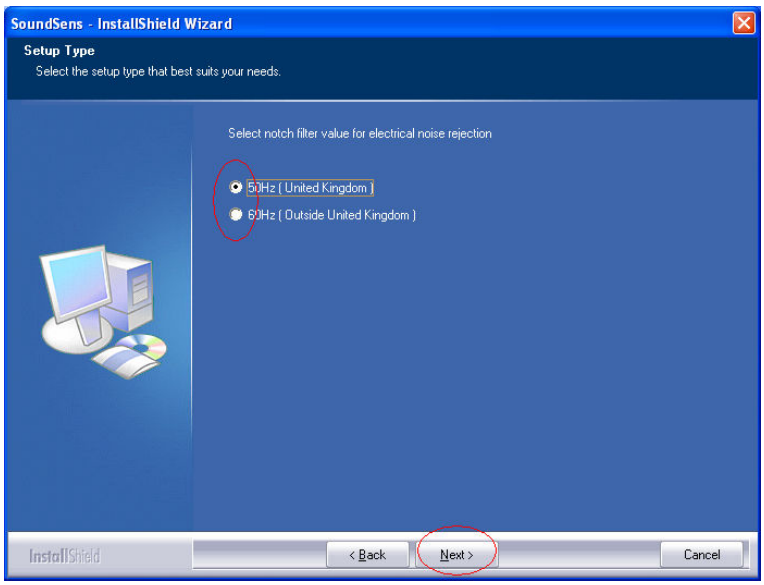
Agree to the license, and then click next.



If you wish to change the location of the installed files you may do so here. Click next to continue.

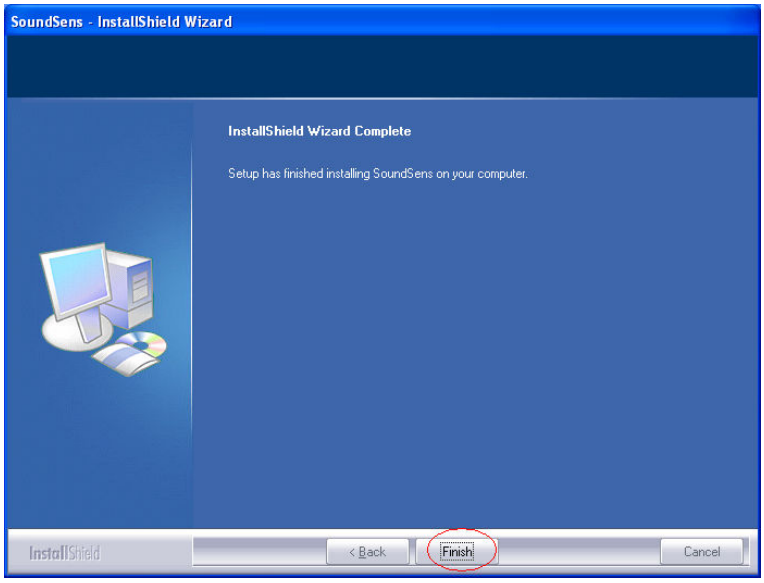


Click install to continue.



Select notch filter value for electrical noise rejection. By default 50Hz is selected for the United Kingdom. Then click next.

(this option can be changed from within the software after installation.
Tools -> Options -> Pipe Layout)



Click Finish to complete the installation.

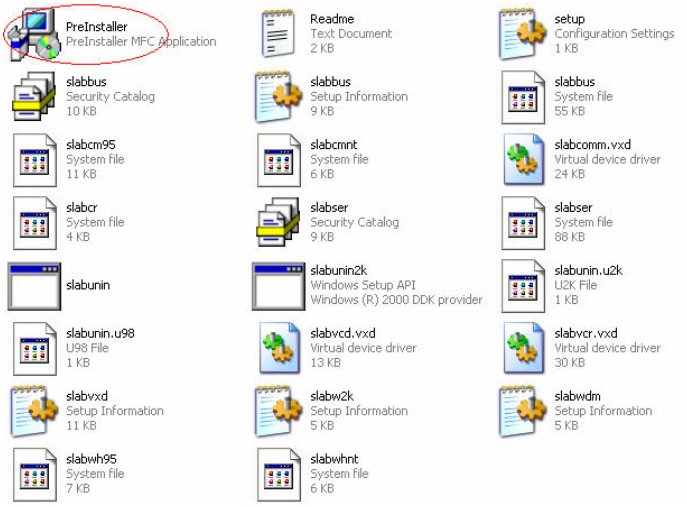
Finally close the Radcom Software Installer.

Please now follow the USB driver instructions.

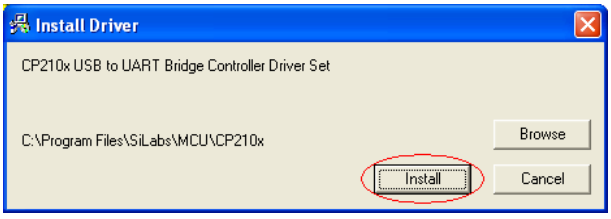
USB Driver Installation Instructions

If you are installing the SoundSens software on a PC which has never had a USB SoundSens case connected to it, you should install the USB driver.

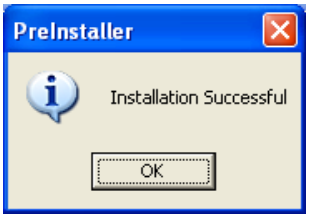
From the installation CD double click the "USB Drivers" folder.



Double click the "PreInstaller" icon.



Click Install to "install" the driver.



The PreInstaller program will display this message if the driver installs correctly. Click OK to continue.